



**SUMMER STEELHEAD STOCK COMPOSITION IN
COLUMBIA RIVER SPORT AND TRIBAL FISHERIES**

JUNE 16, 2021 to OCTOBER 17, 2021

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ACKNOWLEDGEMENTS

This report categorizes the stock composition of the summer steelhead sport harvest in the Columbia River downstream of Bonneville Dam from June 16, 2021 to July 31, 2021 and the Tribal Zone 6 fishery from August 23, 2021 to October 17, 2021. It was a cooperative effort among the Idaho Department of Fish and Game, Washington Department of Fish and Wildlife, and the Pacific States Marine Fish Commission. The authors wish to acknowledge the assistance of staff from all agencies that collected and genotyped the samples. The report that follows is a multi-agency product under the technical lead of Alan Byrne.

ABBREVIATIONS AND ACRONYMS

BON	Bonneville Dam
BWSALM	Big White Salmon River GSI reporting group
BY	Brood Year
CI(s)	Confidence Interval(s)
CRITFC	Columbia River Inter-Tribal Fish Commission
GSI	Genetic Stock Identification
IDFG	Idaho Department of Fish and Game
KLICKR	Klickitat River GSI reporting group
LOWCOL	Lower Columbia River GSI reporting group
lci	Lower Confidence Interval
MFSALM	Middle Fork Salmon River GSI reporting group
MGILCS	Mid-Columbia-Grande Ronde-Imnaha-Lower Snake-Lower Clearwater-Lower Salmon GSI reporting group
ODFW	Oregon Department of Fish and Wildlife
PBT	Parentage Based Tagging
PIT	Passive Integrated Transponder
SFCLWR	South Fork Clearwater River GSI reporting group
SFSALM	South Fork Salmon River GSI reporting group
SKAMAN	Skamania GSI reporting group
TAC	<i>U.S. v Oregon</i> Technical Advisory Committee
uci	Upper Confidence Interval
UPCLWR	Upper Clearwater (Lochsa River and Selway River) GSI reporting group
UPPCOL	Upper Columbia River GSI reporting group
UPSALM	Upper Salmon River GSI reporting group
WILLAM	Willamette River GSI reporting group
WDFW	Washington Department of Fish and Wildlife
YAKIMA	Yakima River GSI reporting group

ABSTRACT

Steelhead passage at Bonneville Dam, from July 1 to October 31, was 67,752 total fish of which 44,227 were adipose-clipped fish and 23,525 were adipose-unclipped fish. This was the smallest return of steelhead between July 1 and October 31 since fish counting began at Bonneville Dam in 1938. The low return of steelhead caused sport fisheries in the lower Columbia River to be constrained with time and area closures and a reduced daily limit. Anglers could retain one clipped steelhead per day in the lower Columbia River sport fishery until it was closed to harvest on August 1, 2021. The Zone 6 Tribal fishery harvested nearly 85,000 fall Chinook Salmon and 3,400 steelhead between August 1 and October 17, 2021. We collected enough samples to make steelhead stock composition estimates, using genetic techniques, in the Lower Columbia River sport fishery from June 16 to July 31 and the Tribal Zone 6 fishery from August 23 to October 17. Over 50% of the Lower Columbia River sport samples could not be assigned with PBT and were likely from hatchery stocks downstream of Bonneville Dam whose broodstock are not included in the PBT baseline. The Snake River basin hatchery stocks made up 32% of the Lower Columbia River sport harvest. In the Tribal Zone 6 fishery, Snake basin hatchery stocks made up 89% of the clipped harvest and 20% of the unclipped harvest. Over 50% of the Tribal Zone 6 unclipped harvest was from the MGLICS GSI stock and about 22% was from Snake basin GSI stocks. Since the MGLICS GSI stock includes rivers in the Snake basin, the percentage of wild steelhead harvest from the Snake basin was likely more than 22%.

INTRODUCTION

The run-timing of summer steelhead into the Columbia River overlaps the run-timing of spring, summer, and fall Chinook Salmon, sockeye, and to a lesser extent coho. Spring, summer, and fall Chinook Salmon are targeted by non-tribal commercial fisheries downstream of Bonneville Dam (BON), tribal commercial, ceremonial, and platform fisheries upstream of BON, and sport fisheries downstream and upstream of BON. All steelhead caught in non-tribal commercial fisheries must be released and only steelhead with a clipped adipose fin (hereafter referred to as clip or clipped) may be kept in sport fisheries. Steelhead, both clipped and those with an intact adipose fin (hereafter referred to as unclip or unclipped) may be retained in any tribal fishery. As defined in the *U.S. v Oregon Management Agreement*, Chinook Salmon fisheries in the Columbia River are managed for three time periods: Upriver spring and Snake River summer Chinook Salmon from January 1 to June 15; upper Columbia River summer Chinook Salmon from June 16 to July 31; and fall Chinook Salmon from August 1 to December 31. Steelhead run sizes, which are used to determine ESA and harvest impacts, are counted at BON during three time periods: winter run from November 1 to March 31, Skamania run from April 1 to June 30, and the Upriver A-Index and B-Index run from July 1 to October 31. A-Index fish are defined as steelhead that are < 78 cm fork length and B-Index as steelhead that are \geq 78 cm fork length that pass BON between July 1 and October 31.

Steelhead harvest is estimated for all tribal and non-tribal fisheries. In sport fisheries, steelhead harvest is estimated in-season with creel surveys on a monthly basis in the Lower Columbia River downstream of BON. Sport catch upstream of BON is estimated monthly from catch record cards and may not be available for several years. Sport steelhead harvest is reported as the number of fish kept. Preliminary steelhead and Chinook Salmon harvest estimates in the Tribal Zone 6 fishery are made on a weekly basis beginning June 16. This allows managers to adjust seasons to keep steelhead impacts and harvest of summer and fall Chinook Salmon within the limits that are outlined in *U.S. v Oregon*. Final harvest estimates are reported by *U.S. v Oregon* Technical Advisory Committee (TAC) at the conclusion of the tribal fishery. Tribal fall season steelhead harvest estimates are reported as the number of clipped and unclipped fish kept that were <78 cm (Small or A-Index) and \geq 78 cm (Large or B-Index).

All adipose clipped fish are known to be hatchery origin. Clipped hatchery fish from the Snake River and other hatcheries could be assigned to a hatchery stock and release group using Parentage Based Tagging (PBT) markers. Clipped steelhead that did not assign using PBT markers were a hatchery fish from an adult whose parents were not genotyped. These PBT unassigned hatchery origin fish were then assigned using Genetic Stock Identification (GSI) markers. Steelhead with an intact adipose fin could be a wild fish or hatchery origin fish released without a clipped adipose fin. Samples from unclipped steelhead GSI were analyzed using PBT markers to determine if the fish was hatchery origin. Unclipped samples that did not assign to a PBT hatchery release group (putative wild fish) were assigned to a Columbia River GSI reporting group. The GSI reporting groups outside of the Snake River basin were developed using wild and hatchery origin steelhead. GSI reporting groups that lie entirely within Idaho in the Snake River basin were developed using wild fish only.

Hatcheries in the Snake River basin release the majority of summer steelhead smolts in the Columbia River basin. Usually over 70% of the total basin smolt releases and about 85% of the smolts released upstream of BON are from Snake River basin hatcheries. The Idaho Department of Fish and Game (IDFG) began collecting genetic samples from hatchery steelhead used for broodstock starting with Brood Year (BY) 2008 at all hatcheries in Idaho. Beginning with BY2009 and continuing each year afterward, all hatchery steelhead used for broodstock in the

Snake River basin have been sampled and genotyped by IDFG, Washington Department of Fish and Wildlife (WDFW), and Oregon Department of Fish and Wildlife (ODFW). The Columbia River Inter-Tribal Fish Commission (CRITFC) has worked with managers to collect samples to genotype steelhead broodstock from non-Snake River hatcheries in the Columbia River beginning with BY2012. Currently, nearly all summer steelhead broodstock from hatcheries upstream of BON are genotyped and in the PBT database and their offspring can be identified with Parental Based Tagging (PBT) methods. Most summer steelhead used for broodstock in hatcheries downstream of BON are not genotyped and their offspring can not be identified with PBT.

The stock composition of summer steelhead in the Columbia River sport and Tribal fisheries has been estimated since 2011 (Byrne et al. 2021, Byrne et al. 2020, Byrne et al. 2018a, Byrne et al. 2018b, Byrne 2018c, Byrne et al. 2016, Byrne et al. 2015, Byrne et. al 2014a and Byrne et. al 2014b). Until this study was initiated, there were no estimates of the harvest contribution of hatchery and wild stocks in the tribal and non-tribal fisheries in the Columbia River.

IDFG coordinated the sampling of steelhead harvested in the Lower Columbia River sport fishery (downstream of Bonneville Dam) and the Tribal Zone 6 fishery in 2021. The cooperators of this effort in 2021 were IDFG, WDFW, and the Pacific States Marine Fish Commission. All dates used in this report are for the year 2021 unless specified otherwise.

METHODS

Steelhead Passage at Bonneville Dam

The daily count of clipped and unclipped steelhead at BON from July 1 to October 31 was obtained from the Fish Passage Center's website (available at https://www.fpc.org/webapps/adultsalmon/Q_adultcounts_dataquery.php). CRITFC personnel sampled steelhead at BON and recorded the fork length and the presence or absence of the adipose fin. Steelhead were designated in-season as hatchery or wild origin primarily based on the presence of fin clips or an eroded dorsal fin. If either was observed, the default designation was hatchery and if both were absent, the default designation was wild origin. Beginning in 2011, CRITFC obtained tissue samples from all steelhead that were handled and used PBT post-season to determine if any unclipped fish were hatchery origin. If an unclipped fish that was visually called wild was later determined to be hatchery origin using genetic analysis, we classified that fish as unclipped hatchery origin. TAC used the post-season data to estimate the percentage of A-Index and B-Index clipped hatchery fish using the clipped samples and the percentage of A-Index and B-Index wild and unclipped hatchery fish using the unclipped samples. These percentages were estimated in six time strata in 2021. The clipped percentages were multiplied by the clipped steelhead dam count and the unclipped percentages were multiplied by the unclipped steelhead dam count in each time stratum to estimate the number of wild and clipped and unclipped hatchery origin A-Index and B-Index fish that passed the dam. The total A-Index and B-Index wild, clipped, and unclipped hatchery passage at BON was the sum of all time periods.

Steelhead Run-Timing at Bonneville Dam

All hatchery summer steelhead stocks in the Snake River basin and several non-Snake hatchery stocks in the Columbia River are representatively Passive Integrated Transponder (PIT) tagged prior to release as smolts. Wild juvenile steelhead are also PIT-tagged throughout the

Columbia River basin. We calculated the run timing of summer steelhead stocks passing BON in 2021 using the date of their first adult detection at BON. We obtained the daily number of adult summer steelhead detections at BON from April 1 to December 31 for wild and hatchery fish that were PIT-tagged upstream of BON except in the Snake River basin. For Snake basin fish we obtained all adult steelhead detections at BON from June 1 to December 31. There were no Snake basin adult steelhead detected at BON before June 1 from return year 2021. The detection data was obtained from the PTAGIS website (<http://www.ptagis.org>). We only used the adult detection data of hatchery and wild summer steelhead that were tagged as juveniles before July 1, 2020 and were returning to spawn in the spring of 2022 (most summer steelhead that spawned in the spring of 2022 passed BON in 2021). Some of the adults were determined to be kelts or smolts based on their detection history at main stem dams and tributary PIT arrays and were removed from the analysis. Repeat spawners were not used to calculate run timing as only fish on their first adult migration upstream were included for the run-timing analysis.

The run-timing of each Snake River hatchery stock, except the Dworshak and Wallowa, were calculated by combining detections from all of the stock's release groups and BYs. The Dworshak stock was split into two groups: fish reared at Dworshak or Clearwater hatcheries and released in the Clearwater drainage (Dwor-C) and those fish reared in the Hagerman Valley hatcheries and released in the Salmon drainage (Dwor-S). The Wallowa stock run-timing split into two stocks. Wallowa-OR were Wallowa smolts released in Oregon and Wallowa-WA were Wallowa smolts released in the Washington. All Wallowa-WA smolt releases were from broodstock collected at the Cottonwood Pond Adult Trap on the lower Grande Ronde River and reared at Lyons Ferry Hatchery. The Wallowa-OR smolt releases were from broodstock collected at Wallowa Hatchery and reared at Irrigon Hatchery. The Skamania stock run-timing was calculated using only fish that were released in the Klickitat River. The middle Columbia River (Mid-C) hatchery run-timing was calculated by combining detections of all non-Snake River summer steelhead hatchery stocks (except Skamania) and BYs released between BON upstream to and including the Yakima River basin. The upper Columbia River (Up-C) hatchery run-timing was calculated by combining detections of all summer steelhead hatchery stocks and BYs released upstream of the Yakima River. The run-timing of wild steelhead from the Mid-C (BON to Yakima River, excluding the Snake River basin), Up-C (all rivers upstream of the Yakima River), and Snake (excluding fish tagged at Snake River mainstem dams) regions was calculated by combining detections from all release sites in each region that were coded as summer run in the PTAGIS database. Fall Chinook Salmon run timing was calculated using the daily and cumulative adult window count at BON from August 1 to November 30. We estimated the cumulative passage proportion for each date of all wild and hatchery steelhead stocks and fall Chinook Salmon at BON. There were many fall Chinook Salmon that spawned downstream of BON and these were not included in the fall Chinook Salmon run timing analysis.

Lower Columbia River Sport Harvest Estimates

Sport anglers could retain one adipose clipped hatchery origin steelhead per day in the Columbia River from Buoy 10 to BON from June 16 to July 31, 2021. The steelhead fishery was closed to retention from August 1 to October 31, 2021 and any steelhead that was caught had to be released.

The recreational sport fishery downstream of BON is divided into ten sampling sections. (Figure 1). Personnel from ODFW and WDFW conduct random angler interviews at their respective boat ramps, beaches, and on the river to determine catch rates for each species in each section. The total number of fish caught and released for each species, month, and section

is estimated by combining total angler effort estimates derived from aerial surveys and bank angler counts with the observed angler catch rates in each section (Watts 2021 and TAC 2008). The steelhead sport harvest is not parsed into hatchery stocks by ODFW and WDFW. There was no catch quota on the harvest of clipped steelhead, however all non-tribal fisheries in the Columbia River from Buoy 10 upstream to the Highway 395 bridge near Pasco, Washington, must not exceed a 2% impact rate on wild A-Index and 2% on wild B-Index steelhead in July. An additional 2% impact on A-Index and B-Index fish is allowed from August 1 to October 31 from Buoy 10 to The Dalles Dam plus impacts from The Dalles Dam to Highway 395 bridge from November 1 to March 31 the following year.

Tribal Zone 6 Harvest Estimates

The Tribal Zone 6 fall fishery primarily targets fall Chinook Salmon. There were eight weekly open set net commercial seasons for tribal fishers from August 23 to October 11, 2021 and we focused our analysis of the Tribal Zone 6 fishery on this time period. In addition to the commercial set net seasons, platform and hook and line fisheries were open daily from August 1 through November 30, 2021. Tribal Zone 6 fisheries during the fall management period can catch significant numbers of steelhead as both species are abundant in Zone 6 during the time period the commercial seasons are open.

The harvest rate for treaty fisheries for the fall management season (August 1 to October 31) is based on a sliding scale of the abundance of upriver fall Chinook Salmon and total B-Index steelhead counted at Bonneville Dam as outlined in *U.S. v. Oregon*. There is no specific harvest rate limit on A-Index steelhead. The allowable harvest rate of total B-Index steelhead in the treaty fall period fishery was 13% in 2021.

Tribal monitors from the Yakama Nation (YN) sample tribal catch at landing points on the Columbia River. Data are collected on number of fish per net, number of nets sampled, numbers of times per day nets are checked, and number of nets each sampled crew were fishing. Steelhead are measured and classified as A-Index (<78 cm) or B-Index (≥78 cm) fish and presence or absence of an adipose fin-clip is noted. WDFW crews sample the tribal catch for biological data at commercial buying stations (ticketed catch). Fork length and presence or absence of the adipose fin was recorded. In cases where the non-ticket catch is a large proportion of the total catch, the YN uses information from the WDFW sampled ticketed catch combined with the YN sampling data to estimate the number of steelhead that were harvested. All tribal steelhead harvest estimates were reviewed and then reported by TAC. Steelhead in-season harvest estimates were made weekly for fall Chinook Salmon and clipped and unclipped A-Index and B-Index steelhead (Yakama Nation and TAC, unpublished data). Final steelhead and fall Chinook Salmon harvest estimates for the fall management period were reported by TAC post-season (JSR 2022a and JSR 2022b).

Sample Collection in the Lower Columbia River Sport Fishery

Sport anglers were sampled by the WDFW creel survey crews that were used to estimate harvest from Buoy 10 upstream to BON. All steelhead that were encountered had a small piece of tissue removed for the genetic analysis. In addition to a tissue sample, crews also checked the fish for a Coded Wire Tag, PIT tag, measured the fork length, and recorded the river section and date the fish was caught. Retention of steelhead was not permitted from August 1 to October 31, 2021. A total of 128 samples were genotyped for analysis of the sport fishery (Table 1). We

estimated the stock composition and harvest contribution from June 16 to July 31, 2021 from these samples.

Sample Collection in the Tribal Zone 6 Fishery

WDFW crews collected samples from tribal caught steelhead in Zone 6 that were sold to commercial buyers on the Washington shore. The first samples were collected on August 24 and the last samples were collected on October 13. Crews measured the fork length, recorded if the fish was clipped or unclipped, and the location and date the fish was caught. A total of 306 clipped samples and 143 unclipped samples were genotyped for analysis of the tribal fishery (Table 2). We estimated the stock composition in the tribal clipped and unclipped harvest, when commercial fishing was permitted, from August 23 to October 17, 2021.

Estimating Composition Proportions

Clipped steelhead are known to be hatchery origin whereas unclipped steelhead could be an unclipped hatchery fish or wild fish. All fish were genotyped at 368 SNPs for an assignment to a GSI reporting group, a possible assignment to a hatchery release group and BY using PBT, and a sex-specific genetic assay for determining the sex of the fish. The genotyping was done at the IDFG genetics lab. The GSI methodology is detailed in Ackerman et al. (2016) along with the methods for extraction of genomic DNA from tissue samples, DNA amplification, and SNP genotyping. Steele et al. (2016) contains similar details for PBT analysis. If a fish was identified with PBT, we assigned the fish to its release group and BY. Unclipped steelhead that were not identified with PBT were either a hatchery-origin fish whose parents were not in the PBT baseline or a wild-origin fish. All PBT unassigned fish (clipped and unclipped) were assigned to their most probable GSI reporting group that was developed by CRITFC and is described in Hess et al. 2013 (Figure 3). All adipose-clipped fish assigned to a GSI group were hatchery origin.

All Snake River basin hatchery release groups were classified by brood year, rearing hatchery, hatchery stock, and release site and the non-Snake River basin hatchery release groups were classified by brood year and stock. All PBT release groups and GSI reporting groups were assigned to a river basin. For the stock composition analysis, the Wallow-WA stock included fish released in the Walla Walla River basin, the Snake River at Lyons Ferry Hatchery, and the Grande Ronde River at the Cottonwood Acclimation Pond. Due to rearing space limitations at Lyons Ferry Hatchery, parental matings of the Wallowa-WA stock cannot be tracked to release site, hence all Wallowa-WA smolt releases were assigned to the Wallowa-WA stock and the Snake basin. The Wallowa-OR stock was from broodstock collected at Wallowa Hatchery, reared at Irrigon Hatchery, and released in the Oregon portion of the Snake River basin. The MGILCS GSI group includes tributaries of the Columbia River from BON to the Snake River mouth, Snake River tributaries downstream of the Clearwater River, the Asotin, Grande Ronde, and Imnaha basins, tributaries of the Salmon River upstream to the Little Salmon River, and tributaries of the Clearwater River upstream to the confluence of the Lochsa and Selway rivers. Since this group spans more than one river basin it was defined as a distinct basin. The SKAMAN GSI group was defined as natural origin steelhead that can trace their ancestry to the Skamania Hatchery stock. This GSI group and Skamania PBT release groups are closely related to each other and are found in the Willamette drainage and Columbia River tributaries upstream and downstream of BON. We treated these groups as a distinct basin since they are found in more than one river basin.

We analyzed the clipped and unclipped tribal samples separately. In sport fisheries, only adipose clipped fish can be retained. The actual count in each PBT release group was divided by its tagrate to get an expanded count. The expanded count can be thought of as the expected number of fish from each release group that would have been sampled if the release group had a tagrate of 1. Since fish were added to hatchery release groups after expanding for their tagrate, an equal number of fish must be subtracted from the fish that were assigned to GSI reporting groups. The composition proportions were calculated using the “accounting” estimator described by Delomas and Hess (2021) to incorporate the tagrates for each PBT release group using the R script *Scobi_duex* performed in the R programming environment (available at: <https://cran.r-project.org>).

The proportion of each hatchery stock’s composition by brood year was found by adding all of the stock’s release group BYs proportions. The proportion of each hatchery stock was found by summing all of the stock’s release groups and BYs. We also present results at the river basin spatial scale for stock composition proportions. Basin level proportions were found by summing all PBT and GSI group proportions within each river basin. All proportions were reported as percentages rounded to the nearest tenth percent except the basin level percentages which were rounded to the nearest percent. Harvest estimates in the Lower Columbia River sport fishery and Zone 6 tribal fishery were calculated by multiplying the stock composition proportions by the reported total harvest estimate and rounding to the nearest fish.

Confidence Intervals for Group, Stock, and Basin Proportions

Confidence intervals (CIs) for the PBT release group’s and GSI reporting group’s estimates were generated using *Scobi_duex*. The script resamples with replacement from an original sample or set of data. For each iteration, the original group assignments were resampled with replacement s number of times where $s =$ the number of samples. Within each iteration, we then calculated the expanded PBT hatchery release group and adjusted GSI reporting group proportions as outlined in the previous section. We performed 10,000 iterations and sorted the proportions in ascending order. The $100(1-\alpha)\%$ CIs for the group proportions were the $(10,000 * \alpha/2)$ and $(10,000 * (1 - \alpha/2))$ values of the ordered bootstrap values. In the analysis we set $\alpha = 0.05$ and report the 90% lower CI (*lci*) and 90% upper CI (*uci*) for all proportions. The CIs for each PBT stock/BY and PBT stock, was found by summing all of the stock’s release groups of each BY and all of the stock’s release groups in each iteration and choosing the $(10,000 * \alpha/2)$ and $(10,000 * (1 - \alpha/2))$ ordered values. The CIs at the basin spatial scale were found by summing all PBT and GSI groups by their basin assignment in each iteration and choosing the $(10,000 * \alpha/2)$ and $(10,000 * (1 - \alpha/2))$ ordered values. All proportion CIs were reported as percentages rounded to the nearest tenth percent. The R package containing *Scobi_duex* can be found at <https://github.com/delomast/fishCompTools>.

Ocean Age and Length Percentages

The percent of 1-ocean fish for all PBT assigned fish was calculated using the actual sum of BY2019 fish and the total actual count of all PBT assignments. The percent of 1-ocean fish was calculated for each hatchery stock and of all stocks in each basin using samples that were identified with PBT if the actual sample size was >10 . For this, we used the expanded count of 1-ocean fish (BY2019) and the sum of the expanded counts of all ocean ages, by stock and basin, that were PBT assigned. Ocean ages were not available for fish that assigned to GSI groups since scale samples were not taken from the sampled fish.

We estimated the number of large (≥ 78 cm or B-Index) and small (< 78 cm or A-Index) steelhead in each hatchery and GSI stock from each fishery by performing a maximum likelihood (ML) estimation of the length composition to estimate the proportions of large and small fish in each stock while accounting for tagrates. The sum of small and large fish for the length analysis may not equal the expanded count for PBT assigned fish or the adjusted count of the GSI assigned fish used to calculate the stock composition proportions for two reasons: 1) the stock composition proportions were calculated using all genotyped samples whereas the length composition proportions were calculated using only samples with length data and 2) the estimators, while similar in logic, are different, and so the estimates will not be identical. The ML method used for length analysis was executed using the R package *fishCompTools* (available at: <https://github.com/delomast/fishCompTools>).

The counts of fish that were PBT assigned (PBT-tagged) to a given hatchery group, n_1, \dots, n_G , with tagrates of t_1, t_2, \dots, t_G or were PBT unassigned, u was considered to be a multinomial random variable,

$$\begin{aligned} (n_1, \dots, n_G, u) &\sim \text{mult}(N, \pi), \\ \pi &= (p_1 t_1, p_2 t_2, \dots, p_G t_G, \gamma), \\ \gamma &= w + \sum_{i=1}^G p_i (1 - t_i), \end{aligned}$$

where p_i is the probability that a fish is from hatchery group i (i.e. assigned with PBT), w is the probability a fish is from a PBT-untagged GSI group (e.g. a wild fish or a hatchery fish that was from an unsampled stock) and γ is the probability that a fish is PBT-untagged. The probability that a fish is PBT-untagged is the sum (because the events are disjoint) of the probabilities that a fish is from a GSI stock (i.e. wild fish or an unsampled hatchery stock) or from a PBT-tagged group that had a tagrate < 1 .

Let the PBT-untagged group be composed of S different genetic stocks, and let u be a vector with u_j being the number of PBT-untagged fish that assign to GSI stock j for j in $1, 2, \dots, S$. The counts of PBT-tagged fish in each hatchery group and the counts of PBT-untagged fish assigned to each stock though GSI was again considered to be a multinomial random variable,

$$\begin{aligned} (n_1, \dots, n_G, u_1, \dots, u_S) &\sim \text{mult}(N, \pi), \\ \pi &= (p_1 t_1, p_2 t_2, \dots, p_G t_G, \gamma_1, \dots, \gamma_S), \\ \gamma_j &= w_j + \sum_{i=1}^G p_i (1 - t_i) D_{ij}, \end{aligned}$$

where γ_j is the probability a fish is PBT-untagged and assigns to stock GSI j , w_j is the probability a fish is from a PBT-untagged group and in GSI stock j , and D_{ij} is the probability a fish in hatchery group i assigns to GSI stock j .

The assigned stocks of the PBT-tagged hatchery fish was also considered to be a multinomial random variable,

$$(O_{i1}, \dots, O_{iS}) \sim \text{mult}(n_i, (D_{i1}, \dots, D_{iS})), \quad (1)$$

where O_{ij} is the number of PBT-tagged fish in hatchery group i that assigned to GSI stock j .

Length was treated as a categorical variable, with fish less than 78 cm being “small” and fish greater than or equal to 78 cm being “large”. We used 78 cm since it is the basis of the A/B-Index summer steelhead management used in *U.S. v. Oregon* fisheries, however a user can input any length desired. We assume that within a given hatchery group the length is independent of the GSI assigned stock. This is likely to be the case unless a hatchery group being estimated is a combination of genetically distinct strains that are only being estimated as one group because tagrates are not available for them separately. Let u now be such that u_{jk} is the number of PBT-untagged fish that assign to GSI stock j and are in length category k with k in $\{1,2\}$. The counts of PBT-tagged fish and PBT-untagged fish in each combination of stock and length category were considered to be a multinomial random variable,

$$\begin{aligned} (n_1, \dots, n_G, u_{11}, \dots, u_{S2}) &\sim \text{mult}(N, \pi), \\ \pi &= (p_1 t_1, p_2 t_2, \dots, p_G t_G, y_{11}, \dots, y_{S2}), \\ y_{jk} &= w_{jk} + \sum_{i=1}^G p_i (1 - t_i) D_{ij} V_{ik}, \end{aligned} \quad (2)$$

where y_{jk} is the probability a fish is PBT-untagged, assigns to GSI stock j , and is in length category k ; w_{jk} is the probability a fish is from a PBT-untagged group, in GSI stock j , and in length category k ; and V_{ik} is the probability a fish in hatchery group i is in length category k .

The number of PBT-tagged fish in a given hatchery group that are in a given length category was considered to be a multinomial random variable,

$$(Q_{i1}, \dots, Q_{iK}) \sim \text{mult}(n_i, (V_{i1}, \dots, V_{iK})), \quad (3)$$

where Q_{ik} is the number of PBT-tagged fish in hatchery group i that were in length category k . The likelihood of the data as a whole, $P(n, u, O, Q | \pi, D, V)$ is the product of three multinomial likelihoods (equations 1, 2, and 3) that can be maximized to infer p , w , D , and V .

The estimates for p , w , and V were multiplied as appropriate to estimate fishery composition by group and size. These estimates were then summed to calculate composition at different scales (stock, basin, and origin). Non-parametric bootstrapping with 10,000 iterations was utilized to calculate 90% lci and uci.

For the Lower Columbia River sport fishery and Tribal Zone 6 clipped and unclipped samples, we report the percentage of the sampled fish and the 90% binomial CI that were large using the actual count of all samples with a valid length measurement. Next, we focus on large fish only, as *U.S. v. Oregon* managed fisheries are often constrained by the abundance of large steelhead. We report the percentage of the large fish from each stock using the large ML proportion estimates and the percentage of large fish within each stock using the ML estimates of large and small proportions within the stock. Non-parametric bootstrapping with 10,000 iterations was utilized to calculate the 90% lci and uci.

RESULTS

Steelhead Passage at Bonneville Dam

Steelhead passage from July 1 to October 31 was 67,752 total fish of which 44,227 were clipped fish and 23,525 were unclipped fish. This was the smallest return of steelhead between July 1 and October 31 since the fish counting began at BON in 1938. The clipped return was made up of 35,723 A-Index (Small) fish and 8,504 B-Index (Large) fish. The estimated preliminary wild passage was 19,626 A-Index fish and 1,136 B-Index fish. The estimated preliminary hatchery unclipped passage was 1,947 A-Index fish and 816 B-Index fish. TAC will adjust and finalize the BON unclipped components during the winter of 2022-23. An adjustment is necessary because the estimated passage of large wild and large hatchery unclipped steelhead at Lower Granite Dam from this return year was greater than estimated at BON.

Steelhead Run-Timing at Bonneville Dam

The Skamania stock released in the Klickitat River was the earliest arriving stock at BON. The 50% arrival date for Skamania stock was on June 17 and was reached nearly two months earlier than the next earliest arriving hatchery stock attained its 50% date. The 90% arrival date for the Skamania hatchery stock was August 19 and was attained before all other hatchery stocks except the Tucannon stock reached their 50% arrival date. The earliest Snake basin hatchery stocks were the Tucannon and Imnaha which had a 50% passage date of August 14 and August 24, respectively. All other Snake River, Mid-C, and Upper-C basin hatchery stocks attained their 50% arrival date between August 26 and September 18. The 50% arrival date for the Snake River hatchery stocks spanned 35 days and ranged from August 14 to September 18 (Figure 4 and Appendix A). Wild fish from the Mid-C, Up-C, and Snake attained their 50% date on August 6, August 9, and August 20, respectively. The aggregate steelhead run-timing in 2021 was later than the recent five year average from 2016 to 2019.

The BON passage of Dwor-C, Dwor-S, SF Clearwater, and Upper Salmon hatchery stocks on August 1, 2021, the day the Lower Columbia sport fishery closed, was 0% for all stocks. The BON passage of all other Snake basin hatchery stocks ranged from 6% to 26% complete. The Mid-C and Up-C hatchery stocks were 16% and 21% complete on August 1. The Skamania stock was 86% complete on August 1. The Snake River wild stock passage on August 1 was 18% complete compared to 32% for the Up-C and 44% for the Mid-C wild stocks (Figure 4 and Appendix A).

Lower Columbia River Sport Harvest Estimate

In the Lower Columbia River sport anglers kept 1,048 steelhead from June 16 to July 31, 2021 (Table 1).

Tribal Zone 6 Fishery Harvest Estimate

During the fall management period the estimated tribal steelhead harvest was 2,008 clipped and 1,387 unclipped steelhead. About 96% of the total steelhead were harvested between August 23 and October 17, 2021 when commercial fishing was permitted. In addition to steelhead,

tribal fishers harvested 84,978 Chinook Salmon (includes jacks) from August 1 to October 17, 2021 (Table 2).

Estimating Composition Proportions And Harvest Contribution

Lower Columbia River Sport

We assigned fish to 23 distinct PBT release groups and five GSI reporting groups for the PBT unassigned fish (Table 3). We estimate that 47.6% of the fish were from the PBT assigned stocks (CI, 39.9% - 55.6%) and that the Snake River hatchery stocks made up 31.6% (CI, 24.9% - 38.7%) of the harvest. The Mid-C hatchery stocks made up 1.6% (CI, 0% - 4%) and the Up-C hatchery stocks made up 7.9% (CI, 3.7% - 12.7%) of the harvest. Wallowa-OR BY2019 was the largest contributor to harvest at the stock/BY scale (7.1%, CI 3.9% - 11%). All other stock/BY assignments each made up less than 5% of the harvest (Table 4).

The Wallowa-OR (8.7%), Pahsimeroi (8.1%), and Skamania (6.5%) stocks had the largest contributions to harvest of the PBT assigned stocks (Table 5 and Figure 4). We assigned 52.4% (CI, 44.4% - 60.1%) to GSI stocks because they did not assign to a PBT release group. The SKAMAN GSI group was the largest contributor to the harvest (42.8%; CI, 35.3% - 50.3%). The remaining PBT unassigned fish were assigned to four GSI stocks that contributed from 1.5% to 4.4% of the harvest (Table 5 and Figure 5). The stock percentages and harvest estimates for each PBT release group can be found in Appendix B.

The Snake basin stocks made up 45% of the harvest and the SKAMAN basin made up 39% of the harvest. All other basins contributed 6% or less of the harvested fish (Figure 6).

Twenty eight of 57 fish assigned with PBT were one-ocean fish (49.1%, CI 37.6% – 60.7%). Two stocks had an actual sample size ≥ 10 . The percent 1-ocean fish was 59.9% in the Pahsimeroi stock and 81.3% in the Wallowa-OR stock using the expanded counts of each BY (Table 5).

Eleven of the 153 sampled fish were large fish (7.2%; CI, 4.1% - 11.6%). The SKAMAN GSI stock made up 35.8% (CI, 11.7% - 61.7%) of the large fish and 9.7% (CI, 0% - 26.6%) came from the Skamania PBT stock. Five other stocks, the Imnaha, Pahsimeroi, Wallowa-OR, Wallowa-WA, and LOWCOL had large fish. The percent of large fish within each stock with large fish present ranged from 32% in the Imnaha stock to 4.4% in the Skamania stock, however only three fish were assigned to the Imnaha stock (Table 4).

Tribal Zone 6

Adipose clipped fish

We assigned the clipped steelhead to 44 distinct PBT release groups and four GSI reporting groups for the PBT unassigned fish (Table 7). We estimate that 95.9% of the fish were from the PBT assigned stocks (CI, 91.7% - 100%) and that the Snake River hatchery stocks made up 89% (CI, 84.3% - 93.3%) of the harvest. The Up-C hatchery stocks made up 4.9% (CI, 2.7% - 7.3%) and the hatchery stocks from the Mid-C made up less than 1% of the harvest. Nearly 38% of the harvest was from BY2018 Dwor-C (28.6%, CI 23.4% - 33.7%) and BY2018 SF Clearwater

(9.1%, CI 6.3% - 12%) whereas, all other stock/BY assignments each made up less than 7% of the harvest (Table 8).

The largest stock contribution to harvest was from Dwor-C (33.2%, CI 27.9% - 38.4%), SF Clearwater (11.5%, CI 8.4% - 14.6%), and Oxbow (10.4%, CI 7.3% - 13.5%). All other stocks each made up less than 9% of the total harvest. We assigned 4.1% (CI, 0% - 8.3%) to GSI stocks because they did not assign to a PBT release group. The SFCLWR GSI stock was the largest GSI stock contributor to the harvest (2.8%; CI, 0% - 5.7%). The other PBT unassigned fish were assigned to three GSI stocks that contributed from 0.1% to 0.8% of the harvest (Table 9 and Figures 7 and 8). The stock percentages and harvest estimates for each PBT release group can be found in Appendix C.

The Snake basin stocks made up 92% of the harvest and the Up-C basin made up 5% of the harvest. All other basins contributed 1% of the harvested fish (Figure 9).

One hundred eight of 263 fish assigned with PBT were one-ocean fish (41.1%, CI 36% - 46.3%). Seven stocks had an actual sample size ≥ 10 . The percent 1-ocean fish in these seven stocks, using the expanded counts of each BY, ranged from 9.4% to 85.3% in the Dwor-C and Sawtooth stocks, respectively (Table 9).

One hundred twenty of the 306 sampled fish were large fish (39.2%; CI, 34.6% - 44%). Four stocks had large fish sampled. The percent of the total large fish from these stocks was; Dwor-C stock 67.8% (CI, 57.9% - 77.2%), SF Clearwater stock 23.2% (CI, 16.7% - 30%), SFCLWR GIS stock 8.2% (CI, 0% - 16.5%) and, Skamania 0.8% (CI, 0% - 2.5). The percent of large fish within each of these four stocks ranged from 80.3% in the Dwor-C stock to 25% in the Skamania stock, however only four fish were assigned to the Skamania stock (Table 10).

Adipose unclipped fish

We assigned the unclipped steelhead to 12 distinct PBT release groups and 10 GSI reporting groups for the PBT unassigned fish (Table 7). We assigned 30 fish to a PBT release group. Due to the low PBT assigned sample size we do not report hatchery stock contributions by Brood Year. We estimate that 22.1% of the unclipped harvest were from the PBT assigned stocks (CI, 16.3% - 28.1%) and that the Snake River hatchery stocks made up 20.4% (CI, 15.1% - 26.3%) of the harvest. The Up-C hatchery stocks made up 1.7% (CI, 0% - 4.2%) of the harvest. We did not make any PBT assignments to other basins. (Table 11). The GSI stocks made up 77.9% (CI, 71.9% - 83.7%) of the harvest. Over 50% of the GSI assignments were to the MGILCS stock (51.4%, CI 44.5% - 58.4%). The other nine GSI stocks each contributed less than 5% to the harvest (Table 11 and Figure 10). The stock percentages and harvest estimates for each PBT release group can be found in Appendix C.

The MGILCS basin made up 66% and the Snake basin 23% of the wild steelhead harvest, respectively. The MGILCS basin includes rivers within the Snake basin hence, the estimate for the Snake basin is likely a minimum value. All other basins made up less than 5% each of the wild steelhead harvest (Figure 11).

Five of the 30 fish assigned with PBT were one-ocean fish (16.7%, CI 6.8% - 31.9%). The SF Clearwater was the only stock with an actual sample size ≥ 10 and all the fish were 2-ocean returns. (Table 11).

Forty three of the 143 sampled fish were large fish (30.1%; CI, 23.8% - 37%). Two PBT and six GSI stocks had large fish sampled. The percent of the total large fish from these stocks was; SF Clearwater stock 36% (CI, 23.3% - 48.6%), Dwor-C stock 17.4% (CI, 8% - 27.8%), UPCLWR GIS stock 14% (CI, 5.5% - 23.1%) and, MGILCS GSI stock 11.6% (CI, 4.3% - 20%). The other four GSI stocks each made up less than 10% of the total large fish. Two stocks, SF Clearwater and MGILCS GSI stock had an actual sample size of ≥ 10 . The percent of large fish within those stocks were 93.7% (CI, 81.8% - 100%) and 6.8% (CI, 2.5% - 12%) for the SF Clearwater and MGILCS, respectively (Table 12).

DISCUSSION

The majority of summer steelhead hatchery smolts released in the Columbia River basin are reared in Snake River basin hatcheries most returning hatchery origin adult steelhead are 1-ocean or 2-ocean fish. Clipped steelhead that were assigned to a GSI group are known to be hatchery origin (because of the clipped adipose fin), whereas unclipped GSI assigned fish are considered to be putative wild fish if they did not assign to a PBT release group. The GSI groups within the Snake River basin were developed using only wild origin fish, however the non-Snake GSI groups were developed using both hatchery and wild origin fish. Nearly all broodstock from hatcheries upstream of BON are genotyped and in the PBT database and have high tagrates, therefore any unclipped fish that were assigned to GSI reporting groups located upstream of BON were likely wild origin. We do not have broodstock from most hatchery programs downstream of BON genotyped and in the PBT database, hence hatchery origin adults from these programs that were sampled in the Lower Columbia River cannot be assigned to a PBT release group. Unclipped steelhead that assigned to GSI reporting groups located downstream of BON could be a wild or an unclipped hatchery origin fish.

The SKAMAN GSI group is very closely related to the Skamania Hatchery stock summer steelhead. Over 99% of known Skamania Hatchery summer steelhead would assign to the SKAMAN GSI reporting group if their PBT assignment was not used. Most of the summer steelhead hatchery programs in the Lower Columbia (Cowlitz and Lewis) and those in the Willamette River basin derived their broodstock from the Skamania summer run stock and their broodstock is not genotyped. We expect that adults sampled from these hatchery programs that are not in the PBT baseline would assign to the SKAMAN GSI reporting group.

The July 1 to October 31, 2021 total steelhead count at BON was the lowest since the dam was completed in 1938 and the unclipped count was the lowest since clip/unclip counting began in 1994. Sport fisheries were constrained by time and area closures in 2021. The Lower Columbia River sport harvest from June 16 to July 31 was 1,048 and was the lowest harvest in that time period since 2000. Retention of steelhead was not permitted in the Lower Columbia River from August 1 to October 31 in 2021. It follows that if few fish get caught, few get sampled. Although we sampled about 12% of the estimated number of fish harvested, our final sample size was 128. In the Tribal Zone 6 fishery we sampled about 11% and 16% of the estimated unclipped and clip harvest, respectively from August 23 to October 17. The final sample sizes in the Tribal fishery were 143 unclipped and 306 clipped fish. Due to the low sample size in the Lower Columbia River sport and the unclipped Tribal Zone 6 fisheries, the estimated stock and harvest composition estimates in these fisheries should be viewed cautiously. The reported CIs reflect the lack of precision in most estimates because of the low sample size.

The Snake basin made up about 32% of the harvest in the Lower Columbia River sport fishery and was composed of the early arriving stocks. The Skamania PBT and SKAMAN GSI stocks made up nearly 50% of the harvest. About 43% of the harvest was from the SKAMAN GSI stock and likely were from Columbia River hatcheries downstream of BON and the Willamette River. We did not assign any of the harvest to the Dwor-C, SF Clearwater, Upper Salmon, or Dwor-S stocks, which were the latest arriving hatchery steelhead stocks. The percentage of passage at BON on August 1, when this fishery closed, was 0% for each of these later timed stocks. In this fishery we have seen a consistent increase in the stock contribution from the Snake basin as the season progresses in all years since 2011. Had the river been open to harvest after July 31, most of the harvest would have shifted to Snake basin hatchery stocks based on prior years analysis of the monthly stock composition of the catch. The early closure of this fishery weighted the catch to the earlier arriving stocks, primarily the Skamania PBT and SKAMAN GSI stocks, and caused the Snake basin contribution to be lower than usual.

All large fish sampled in the Lower Columbia sport fishery were from three stocks—Skamania (59.1%), SKAMAN (29.8%), and Wells (11.1%). As discussed previously, we expect that clipped steelhead that assigned to the SKAMAN GSI group were from hatcheries downstream of BON. Typically, the number of large fish from Snake basin stocks caught in this fishery increases in August as the Dwor-C and SF Clearwater stocks arrive, however this year the season was closed on August 1 and no Dwor-C or SF Clearwater fish were sampled between June 16 and July 31.

The Tribal Zone 6 stock composition estimates were made during the time period that tribal commercial fishing was permitted. The platform and hook and line tribal fishery caught 144 steelhead before commercial fishing began and represented about 4% of the total fall season tribal harvest. After the last commercial season during the week of October 11, hook and line and platform tribal fishing was permitted, however no steelhead were harvested (S. Ellis, CRITFC, personal comm.) More than 70% of the total passage at BON of each hatchery stock except Skamania and the Snake wild stock occurred between August 1 and October 17. The percentage of the total passage of the four late Snake basin hatchery stocks (Dwor-C, Dwor-S, SF Clearwater, and Upper Salmon) at BON from August 1 to October 17 ranged from 90% to 100% (Appendix A). The Dwor-C stock made up 33% of the clipped tribal harvest and the other Snake basin stocks made up 56% of the clipped harvest. We estimate that 22% and 78% of the unclipped harvest was from hatchery and wild stocks, respectively. About 20% of the unclipped harvest was from Snake basin hatchery stocks and 2% from the Upper Columbia basin. Over 50% of the wild steelhead were from the MGILCS GSI stock and 22% from Snake basin GSI stocks. Since the MGILCS GSI stock includes rivers in the Snake basin, the percentage of wild steelhead harvest from the Snake basin was likely more than 22%.

Most of the large steelhead caught in the Tribal Zone 6 fishery were Snake basin stocks. About 39% of the total clipped harvest were large steelhead. The Dwor-C and SF Clearwater stocks made up 91% of the clipped large harvest. Less than 1% of the large clipped harvest came from the Skamania stock and the remaining 8% was assigned to the SFCLWR GSI stock. About 30% of the total unclipped harvest were large steelhead. We estimated that 53% of the unclipped large fish were hatchery origin and 47% were wild steelhead. Over 86% of the total unclipped harvest came from Snake basin stocks. All of the unclipped hatchery origin large fish were from the Dwor-C or SF Clearwater stocks.

Wild fish made up about 47% of the Tribal Zone 6 unclipped large fish harvest and were assigned to six GSI stocks. The UPCLWR (14%), MGILCS (12%), and SFCLWR (9%) contributed the most large wild steelhead, whereas the other three GSI stocks each contributed between 2%

and 7% each of the total large unclipped harvest. When we consider the large wild fish harvest only, the Snake basin stocks contributed 70% of the large wild steelhead. The MGILCS GSI stock made up 25% and the UPPCOL made up 5% of the large wild steelhead harvest in tribal fisheries. Since the MGILCS GSI stock includes rivers in the Snake basin, the contribution of wild large steelhead from the Snake basin is likely higher than 70%.

In both the sport and tribal fisheries, most large hatchery steelhead were Dwor-C and SF Clearwater stocks and most large wild steelhead were from Snake basin GSI stocks. The stocks that contribute most of the large steelhead have a run-timing that is similar to fall Chinook Salmon, hence steelhead encountered in sport or commercial fisheries from late August through October will more likely be from these later timed stocks and more of the steelhead will likely be large compared to fisheries prosecuted in July and early August.

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Table 1. Estimated harvest and the number of steelhead sampled in the Lower Columbia River sport fishery from June 16 to July 31, 2021.

Period	Harvest	Samples	Percent of total per period	
			Harvest	Samples
June 16 - June 30	384	30	36.6%	23.4%
July 1 - July 31	664	98	63.4%	76.6%
Total	1,048	128	--	--

Table 2. Estimated weekly steelhead and Chinook Salmon harvest and the number of clipped and unclipped steelhead sampled in the Tribal Zone 6 fishery from August 1 to October 17, 2021 and the weekly percentage of the total clipped and unclipped steelhead harvest and samples. The Chinook Salmon harvest includes jacks. Fishing with hook and line and from platforms was permitted after October 17 however no steelhead or Chinook Salmon harvest was reported.

Monday start	Clip harvest	Clip samples	Percent of clip		Unclip harvest	Unclip samples	Percent of unclip		Chinook harvest
			Harvest	Samples			Harvest	Samples	
8/1 to 8/22 ^a	92	0	4.6%	--	53	0	3.8%	--	475
8/23	127	14	6.3%	4.6%	98	7	7.0%	4.9%	6,841
8/30	283	22	14.1%	7.2%	196	6	14.1%	4.2%	21,122
9/6	316	64	15.8%	20.9%	233	34	16.8%	23.8%	24,479
9/13	322	72	16.0%	23.5%	190	30	13.7%	21.0%	16,667
9/20	269	76	13.4%	24.8%	181	47	13.0%	32.9%	7,566
9/27	314	16	15.6%	5.2%	191	4	13.7%	2.8%	4,666
10/4	151	30	7.5%	9.8%	131	7	9.5%	4.9%	2,192
10/11	133	12	6.6%	3.9%	115	8	8.3%	5.6%	969
Total	2,008	306			1,387	143			84,978

^a Commercial fishing was not allowed. The estimated harvest was from hook and line and platform fishing.

Table 3. All distinct PBT release groups with their stock assignment, basin assignment, brood year (BY), and tagrate that were sampled in the Lower Columbia River sport fishery from June 16 to July 31, 2021. The GSI stock assignment was used for fish that were not assigned to a PBT release group. All steelhead harvested were adipose clipped.

PBT release group	Stock	Basin	BY	Tagrate
2018-HNFH-SAWT-SawtoothFH-AdClip	Sawtooth	Snake	2018	0.9086
2018-IRRI-WALL-WallowaR	Wallowa-OR	Snake	2018	0.9597
2018-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	Wallowa-WA	Snake	2018	0.9098
2018-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	Oxbow	Snake	2018	0.9344
2018-NIAG-PAHS-LittleSalmonR-AdClip	Pahsimeroi	Snake	2018	0.9
2018-NIAG-PAHS-PahsimeroiR-AdClip	Pahsimeroi	Snake	2018	0.9789
2019-HNFH-SAWT-SawtoothFH-AdClip	Sawtooth	Snake	2019	0.8824
2019-IRRI-IMNA-Imnaha	Imnaha	Snake	2019	0.9683
2019-IRRI-WALL-WallowaR	Wallowa-OR	Snake	2019	0.9959
2019-LYON-TUCA-TucannonR-WA	Tucannon	Snake	2019	0.9706
2019-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	Wallowa-WA	Snake	2019	1
2019-MVFH-PAHS-LittleSalmonR-AdClip	Pahsimeroi	Snake	2019	0.9753
2019-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	Oxbow	Snake	2019	0.9159
2019-NIAG-PAHS-PahsimeroiR-AdClip	Pahsimeroi	Snake	2019	0.9557
Deschutes2019	Deschutes	Mid-C	2019	0.9583
Skamania2017	Skamania	SKAMAN	2017	0.9403
Skamania2018	Skamania	SKAMAN	2018	0.984
Umatilla2017	Umatilla	Mid-C	2017	0.9728
Wells2017	Wells	Up-C	2017	0.9551
Wells2018	Wells	Up-C	2018	0.625
Wells2019	Wells	Up-C	2019	0.8468
Winthrop2017	Winthrop	Up-C	2017	1

Table 3 (continued)

PBT release group	Stock	Basin	BY	Tagrate
Winthrop2018	Winthrop	Up-C	2018	0.97
PBT Unassigned, GSI stock assignment was used	LOWCOL	Low-C	na	na
PBT Unassigned, GSI stock assignment was used	MGILCS	MGILCS	na	na
PBT Unassigned, GSI stock assignment was used	SKAMAN	SKAMAN	na	na
PBT Unassigned, GSI stock assignment was used	UPPCOL	Up-C	na	na
PBT Unassigned, GSI stock assignment was used	UPSALM	Snake	na	na

Table 4. Stock composition and harvest estimates by stock and brood year (BY) in the Lower Columbia sport fishery, June 16 to July 31, 2021. All fish were adipose clipped. The GSI assignment was used for fish that did not assign to a PBT release group. The total estimated harvest was 1,048. The sum of the stock and BY harvest components may not equal the total or basin percent and harvest estimates due to rounding error.

Stock	BY	Sample size		Percent by stock and BY			Harvest by stock and BY		
		Actual	Adjust	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
<i>All PBT assigned</i>		57	60.99	47.6%	39.9%	55.6%	499	418	583
Skamania	2017	5	5.32	4.2%	1.7%	7.5%	44	17	78
Skamania	2018	3	3.05	2.4%	0.8%	4.8%	25	8	50
<i>Mid-C basin PBT assigned</i>		2	2.07	1.6%	0.0%	4.0%	17	0	42
Deschutes	2019	1	1.04	0.8%	0.0%	2.4%	9	0	26
Umatilla	2017	1	1.03	0.8%	0.0%	2.4%	8	0	25
<i>Snake basin PBT assigned</i>		39	40.46	31.6%	24.9%	38.7%	331	261	406
Imnaha	2019	1	1.03	0.8%	0.0%	2.4%	8	0	25
Oxbow	2018	5	5.35	4.2%	1.7%	7.5%	44	18	79
Oxbow	2019	2	2.18	1.7%	0.0%	3.4%	18	0	36
Pahsimeroi	2018	4	4.18	3.3%	0.8%	5.9%	34	8	61
Pahsimeroi	2019	6	6.24	4.9%	1.6%	8.1%	51	17	85
Sawtooth	2018	1	1.10	0.9%	0.0%	2.6%	9	0	27
Sawtooth	2019	1	1.13	0.9%	0.0%	2.7%	9	0	28
Tucannon	2019	1	1.03	0.8%	0.0%	2.4%	8	0	25
Wallowa-OR	2018	2	2.08	1.6%	0.0%	4.1%	17	0	43
Wallowa-OR	2019	9	9.04	7.1%	3.9%	11.0%	74	41	115
Wallowa-WA	2018	1	1.10	0.9%	0.0%	2.6%	9	0	27
Wallowa-WA	2019	6	6.00	4.7%	1.6%	7.8%	49	16	82
<i>Up-C basin PBT assigned</i>		8	10.09	7.9%	3.7%	12.7%	83	39	133

Table 4 (continued)

Stock	BY	Sample size		Percent by stock and BY			Harvest by stock and BY		
		Actual	Adjust	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
Wells	2017	1	1.05	0.8%	0.0%	2.5%	9	0	26
Wells	2018	3	4.80	3.8%	1.3%	7.5%	39	13	79
Wells	2019	1	1.18	0.9%	0.0%	2.8%	10	0	29
Winthrop	2017	1	1.00	0.8%	0.0%	2.3%	8	0	25
Winthrop	2018	2	2.06	1.6%	0.0%	4.0%	17	0	42
<i>PBT unassigned</i>		71	67.01	52.4%	44.4%	60.1%	549	465	630

Table 5. Stock composition and harvest estimates by stock in the Lower Columbia sport fishery, June 16 to July 31, 2021. All fish were adipose clipped. The GSI assignment was used for fish that did not assign to a PBT release group. The stock percent and harvest estimates may not equal the sum of the BY components in Table 4 or the basin estimate due to rounding error.

Stock	Sample size		Percent by stock			Harvest by stock			Percent 1 ocean
	Actual	Adjusted	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci	
Skamania	8	8.37	6.5%	3.2%	10.5%	68	34	110	
<u>Mid-C basin</u>	2	2.07	1.6%	0.0%	4.0%	17	0	42	
Deschutes	1	1.04	0.8%	0.0%	2.4%	9	0	26	
Umatilla	1	1.03	0.8%	0.0%	2.4%	8	0	25	
<u>Snake basin</u>	39	40.46	31.6%	24.9%	38.7%	331	261	406	65.9%
Imnaha	1	1.03	0.8%	0.0%	2.4%	8	0	25	
Oxbow	7	7.53	5.9%	2.5%	9.3%	62	26	97	
Pahsimeroi	10	10.41	8.1%	4.1%	12.2%	85	43	128	59.9%
Sawtooth	2	2.23	1.7%	0.0%	4.3%	18	0	45	
Tucannon	1	1.03	0.8%	0.0%	2.4%	8	0	25	
Wallowa-OR	11	11.12	8.7%	4.7%	12.7%	91	50	133	81.3%
Wallowa-WA	7	7.10	5.5%	2.3%	8.9%	58	25	93	
<u>Up-C basin</u>	8	10.09	7.88%	3.68%	12.67%	83	39	133	
Wells	5	7.03	5.5%	2.1%	9.7%	58	22	101	
Winthrop	3	3.06	2.4%	0.8%	4.8%	25	8	50	
<u>PBT Unassigned</u>	71	67.01	52.4%	44.4%	60.1%	549	465	630	
LOWCOL	2	1.89	1.5%	0.0%	3.1%	15	0	32	
MGILCS	6	5.66	4.4%	1.5%	7.5%	46	16	78	
SKAMAN	58	54.74	42.8%	35.3%	50.3%	448	370	527	
UPPCOL	2	1.89	1.5%	0.0%	3.1%	15	0	32	
UPSALM	3	2.83	2.2%	0.7%	4.5%	23	7	47	

Table 6. The number of all fish and large fish (≥ 78 cm) sampled by stock and the maximum likelihood (ML) estimate of the percentage of the large fish from each stock and the percentage of fish within each stock that were large in the Lower Columbia River sport fishery from June 16 to July 31, 2021.

Stock	Actual number sampled	Actual number of large fish	ML percent of total large	ML total 90% lci	ML total 90% uci	ML percent large within stock	ML within 90% lci	ML within 90% uci
All samples	128	9	--	--	--	--	--	--
Skamania	8	5	59.1%	26.6%	88.6%	63.6%	34.3%	100.0%
Deschutes	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Imnaha	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oxbow	7	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pahsimeroi	10	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sawtooth	2	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tucannon	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Umatilla	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wallowa-OR	11	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wallowa-WA	7	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wells	5	1	11.1%	0.0%	33.3%	14.3%	0.0%	45.9%
Winthrop	3	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<u>Hatchery clipped assigned with GSI</u>								
LOWCOL	2	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MGILCS	6	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SKAMAN	58	3	29.8%	2.6%	60.1%	4.7%	0.6%	9.9%
UPPCOL	2	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
UPSALM	3	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 7. All distinct PBT release groups with their stock assignment, basin assignment, and brood year (BY), that were sampled in the Tribal Zone 6 fishery 2021. The GSI stock assignment was used for fish that were not assigned to a PBT release group. Unclipped fish assignments from release groups designated as AdClip were likely mis-clipped when fish were marked before being released.

PBT release group	Stock	Basin	BY	Tagrate
<i><u>Distinct assignments in both clipped and unclipped fish</u></i>				
2018-CLWH-SFCR-MeadowCr-AdClip	SF Clearwater	Snake	2018	0.9333
2018-CLWH-SFCR-RedHouse-AdClip	SF Clearwater	Snake	2018	0.925
2018-DWOR-DWOR-NFClearwaterR-AdClip	Dwor-C	Snake	2018	0.8565
2019-IRRI-IMNA-Imnaha	Imnaha	Snake	2019	0.9683
2019-NIAG-PAHS-PahsimeroiR-AdClip	Pahsimeroi	Snake	2019	0.9557
Wells2019	Wells	Up-C	2019	0.8468
PBT Unassigned, GSI stock assignment was used	MFSALM	Snake	na	na
PBT Unassigned, GSI stock assignment was used	MGILCS	MGILCS	na	na
PBT Unassigned, GSI stock assignment was used	SFCLWR	Snake	na	na
PBT Unassigned, GSI stock assignment was used	UPSALM	Snake	na	na
<i><u>Distinct assignments in clipped fish</u></i>				
2017-CLWH-SFCR-MeadowCr-AdClip	SF Clearwater	Snake	2017	1
2017-DWOR-DWOR-NFClearwaterR-AdClip	Dwor-C	Snake	2017	0.8909
2017-DWOR-DWOR-RedHouse-AdClip	Dwor-C	Snake	2017	0.9625
2017-IRRI-WALL-GrandeRondeR/WallowaR	Wallowa-OR	Snake	2017	0.9831
2017-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	Oxbow	Snake	2017	0.5472
2017-NIAG-PAHS-PahsimeroiR-AdClip	Pahsimeroi	Snake	2017	0.9697
2018-DWOR-DWOR-ClearCr-AdClip	Dwor-C	Snake	2018	0.2855
2018-DWOR-DWOR-RedHouse-AdClip	Dwor-C	Snake	2018	0.9275
2018-HNFH-SAWT-SawtoothFH-AdClip	Sawtooth	Snake	2018	0.9086
2018-IRRI-WALL-WallowaR	Wallowa-OR	Snake	2018	0.9597

Table 7(continued)

PBT release group	Stock	Basin	BY	Tagrate
2018-LYON-TUCA-TucannonR-WA	Tucannon	Snake	2018	0.8929
2018-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	Wallowa-WA	Snake	2018	0.9098
2018-MVFH-PAHS-LittleSalmonR-AdClip	Pahsimeroi	Snake	2018	0.9091
2018-NIAG-OXBO-LittleSalmonR-AdClip	Oxbow	Snake	2018	0.9348
2018-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	Oxbow	Snake	2018	0.9344
2018-NIAG-PAHS-LittleSalmonR-AdClip	Pahsimeroi	Snake	2018	0.9
2018-NIAG-PAHS-PahsimeroiR-AdClip	Pahsimeroi	Snake	2018	0.9789
2019-CLWH-SFCR-MeadowCr-AdClip	SF Clearwater	Snake	2019	0.9747
2019-CLWH-SFCR-RedHouse-AdClip	SF Clearwater	Snake	2019	0.9508
2019-DWOR-DWOR-ClearCr-AdClip	Dwor-C	Snake	2019	1
2019-DWOR-DWOR-NFClearwaterR-AdClip	Dwor-C	Snake	2019	0.9389
2019-DWOR-DWOR-RedHouse-AdClip	Dwor-C	Snake	2019	0.9324
2019-HNFH-SAWT-SawtoothFH-AdClip	Sawtooth	Snake	2019	0.8824
2019-IRRI-WALL-WallowaR	Wallowa-OR	Snake	2019	0.9959
2019-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	Wallowa-WA	Snake	2019	1
2019-MVFH-PAHS-LittleSalmonR-AdClip	Pahsimeroi	Snake	2019	0.9753
2019-MVFH-SAWT-SawtoothFH-AdClip	Sawtooth	Snake	2019	0.9242
2019-NIAG-OXBO-LittleSalmonR-AdClip	Oxbow	Snake	2019	0.9643
2019-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	Oxbow	Snake	2019	0.9159
2019-NIAG-PAHS-LittleSalmonR-AdClip	Pahsimeroi	Snake	2019	0.7631
Deschutes2018	Deschutes	Mid-C	2018	0.985
Deschutes2019	Deschutes	Mid-C	2019	0.9583
Skamania2017	Skamania	SKAMAN	2017	0.9403
Skamania2018	Skamania	SKAMAN	2018	0.984
Skamania2019	Skamania	SKAMAN	2019	0.9869
Wells2018	Wells	Up-C	2018	0.625
Winthrop2017	Winthrop	Up-C	2017	1

Table 7(continued)

PBT release group	Stock	Basin	BY	Tagrate
Winthrop2018	Winthrop	Up-C	2018	0.97
<i>Distinct assignments in unclipped fish</i>				
2017-DWOR-DWOR-LoloCr-NoClip	Dwor-C	Snake	2017	1
2018-CLWH-SFCR-MeadowCr-NoClip	SF Clearwater	Snake	2018	0.9677
2018-CLWH-SFCR-NewsomeCr-NoClip	SF Clearwater	Snake	2018	1
2018-DWOR-DWOR-RedHouse-NoClip	Dwor-C	Snake	2018	0.9574
2019-HNFH-EFNAT-EastForkSalmonR-NoClip	EF Salmon	Snake	2019	1
Winthrop2019	Winthrop	Up-C	2019	0.8115
PBT Unassigned, GSI stock assignment was used	KLICKR	Mid-C	na	na
PBT Unassigned, GSI stock assignment was used	LOWCOL	Low-C	na	na
PBT Unassigned, GSI stock assignment was used	SFSALM	Snake	na	na
PBT Unassigned, GSI stock assignment was used	SKAMAN	SKAMAN	na	na
PBT Unassigned, GSI stock assignment was used	UPCLWR	Snake	na	na
PBT Unassigned, GSI stock assignment was used	UPPCOL	Up-C	na	na

Table 8. Stock composition and harvest estimates by stock and brood year (BY) of clipped steelhead in the Tribal Zone 6 fishery, August 23 to October 17, 2021. All fish were adipose clipped. The GSI assignment was used for fish that did not assign to a PBT release group. The estimated clipped harvest from August 23 to October 17 was 1,916. The sum of the stock and BY harvest components may not equal the total or basin percent and harvest estimates due to rounding error.

Stock	BY	Sample size		Percent by stock and BY			Harvest by stock and BY		
		Actual	Adjust	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
<i>All PBT assigned</i>		263	293.35	95.9%	91.7%	100.0%	1,837	1,757	1,916
Skamania	2017	1	1.06	0.3%	0.0%	1.0%	7	0	20
Skamania	2018	1	1.02	0.3%	0.0%	1.0%	6	0	19
Skamania	2019	2	2.03	0.7%	0.0%	1.3%	13	0	25
<i>Mid-C basin PBT assigned</i>		2	2.06	0.7%	0.0%	1.7%	13	0	32
Deschutes	2018	1	1.02	0.3%	0.0%	1.0%	6	0	19
Deschutes	2019	1	1.04	0.3%	0.0%	1.0%	7	0	20
<i>Snake basin PBT assigned</i>		245	272.24	89.0%	84.3%	93.3%	1,705	1,616	1,787
Dwor-C	2017	4	4.41	1.4%	0.4%	2.8%	28	7	55
Dwor-C	2018	72	87.57	28.6%	23.4%	33.7%	548	449	646
Dwor-C	2019	9	9.53	3.1%	1.4%	4.9%	60	27	93
Imnaha	2019	7	7.23	2.4%	1.0%	4.0%	45	19	78
Oxbow	2017	1	1.83	0.6%	0.0%	1.8%	11	0	34
Oxbow	2018	14	14.98	4.9%	2.8%	7.0%	94	54	134
Oxbow	2019	14	15.01	4.9%	2.8%	7.0%	94	54	135
Pahsimeroi	2017	1	1.03	0.3%	0.0%	1.0%	6	0	19
Pahsimeroi	2018	5	5.28	1.7%	0.7%	3.1%	33	13	60
Pahsimeroi	2019	19	20.28	6.6%	4.3%	9.1%	127	82	175
Sawtooth	2018	3	3.30	1.1%	0.0%	2.2%	21	0	41
Sawtooth	2019	17	19.21	6.3%	4.0%	8.9%	120	77	170

Table 8 (continued)

Stock	BY	Sample size		Percent by stock and BY			Harvest by stock and BY		
		Actual	Adjust	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
SF Clearwater	2017	2	2.00	0.7%	0.0%	1.3%	13	0	25
SF Clearwater	2018	26	27.99	9.1%	6.3%	12.0%	175	121	229
SF Clearwater	2019	5	5.16	1.7%	0.7%	3.0%	32	13	58
Tucannon	2018	3	3.36	1.1%	0.4%	2.2%	21	7	42
Wallowa-OR	2017	1	1.02	0.3%	0.0%	1.0%	6	0	19
Wallowa-OR	2018	7	7.29	2.4%	1.0%	4.1%	46	20	78
Wallowa-OR	2019	16	16.07	5.3%	3.3%	7.5%	101	63	145
Wallowa-WA	2018	7	7.69	2.5%	1.1%	4.3%	48	21	83
Wallowa-WA	2019	12	12.00	3.9%	2.3%	5.9%	75	44	113
<i>Up-C basin PBT assigned</i>		12	14.95	4.9%	2.7%	7.3%	94	51	139
Wells	2018	3	4.80	1.6%	0.5%	3.1%	30	10	60
Wells	2019	6	7.09	2.3%	0.8%	3.9%	44	15	74
Winthrop	2017	1	1.00	0.3%	0.0%	1.0%	6	0	19
Winthrop	2018	2	2.06	0.7%	0.0%	1.7%	13	0	32
<i>PBT unassigned</i>		43	12.65	4.1%	0.0%	8.3%	79	0	159

Table 9. Stock composition and harvest estimates of clipped steelhead by stock in the Tribal Zone 6 fishery, August 23 to October 23, 2021. All fish were adipose clipped. The GSI assignment was used for fish that did not assign to a PBT release group. The stock percent and harvest estimates may not equal the sum of the BY components in Table 8 or the basin estimate due to rounding error.

Stock	Sample size		Percent by stock			Harvest by stock			Percent 1 ocean
	Actual	Adjust	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci	
Skamania	4	4.11	1.3%	0.3%	2.6%	26	6	51	
<u>Mid-C basin</u>	2	2.06	0.7%	0.0%	1.7%	13	0	32	
Deschutes	2	2.06	0.7%	0.0%	1.7%	13	0	32	
<u>Snake basin</u>	245	272.24	89.0%	84.3%	93.3%	1,705	1,616	1,787	38.4%
Dwor-C	85	101.51	33.2%	27.9%	38.4%	636	534	736	9.4%
Imnaha	7	7.23	2.4%	1.0%	4.0%	45	19	78	
Oxbow	29	31.82	10.4%	7.3%	13.5%	199	141	260	47.2%
Pahsimeroi	25	26.59	8.7%	6.1%	11.5%	166	117	220	76.3%
Sawtooth	20	22.52	7.4%	4.8%	10.0%	141	92	191	85.3%
SF Clearwater	33	35.15	11.5%	8.4%	14.6%	220	161	281	14.7%
Tucannon	3	3.36	1.1%	0.4%	2.2%	21	7	42	
Wallowa-OR	24	24.38	8.0%	5.6%	10.6%	153	108	203	65.9%
Wallowa-WA	19	19.69	6.4%	4.1%	8.9%	123	78	170	60.9%
<u>Up-C basin</u>	12	14.95	4.9%	2.7%	7.3%	94	51	139	47.4%
Wells	9	11.89	3.9%	1.8%	6.1%	74	35	117	
Winthrop	3	3.06	1.0%	0.0%	2.0%	19	0	38	
<u>PBT Unassigned</u>	43	12.65	4.1%	0.0%	8.3%	79	0	159	na
MFSALM	1	0.29	0.1%	0.0%	0.3%	2	0	7	
MGILCS	8	2.35	0.8%	0.0%	1.8%	15	0	34	
SFCLWR	29	8.53	2.8%	0.0%	5.7%	53	0	109	
UPSALM	5	1.47	0.5%	0.0%	1.2%	9	0	23	

Table 10. The number of all clipped fish and clipped large fish (≥ 78 cm) sampled by stock and the maximum likelihood (ML) estimate of the percentage of the large fish from each stock and the percentage of fish within each stock that were large in the Tribal Zone 6 fishery from August 17 to October 23, 2021.

Stock	Actual number sampled	Actual number of large fish	ML percent of total large	ML total 90% lci	ML total 90% uci	ML percent large within stock	ML within 90% lci	ML within 90% uci
All samples	306	120	--	--	--	--	--	--
Deschutes	2	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Dwor-C	85	67	67.8%	57.9%	77.2%	80.3%	73.4%	87.2%
Imnaha	7	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oxbow	29	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pahsimeroi	25	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sawtooth	20	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SF Clearwater	33	26	23.2%	16.7%	30.0%	79.2%	67.2%	90.3%
Skamania	4	1	0.8%	0.0%	2.5%	25.0%	0.0%	66.7%
Tucannon	3	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wallowa-OR	24	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wallowa-WA	19	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wells	9	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Winthrop	3	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<u>Hatchery clipped assigned with GSI</u>								
MFSALM	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MGILCS	8	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SFCLWR	29	26	8.2%	0.0%	16.5%	92.6%	42.1%	100.0%
UPSALM	5	0	0.0%	0.0%	0.0%	NA	0.0%	0.0%

Table 11. The percentage and harvest estimates of unclipped hatchery origin fish (HNC) by stock and brood year (BY) and the percentage and harvest estimates of unclipped wild origin fish by GSI stock in the unclipped Tribal Zone 6 fishery from August 23 to October 17, 2021. The unclipped harvest estimate was 1,334. The sum of the harvest components may not equal the total unclipped harvest estimate due to rounding error.

Stock	Sample size		Percent by stock			Harvest by stock			Percent 1 ocean
	Actual	Adjusted	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci	
<u>Unclipped hatchery origin--PBT assigned</u>									
<i>All HNC</i>	30	31.61	22.1%	16.3%	28.1%	295	218	375	16.7%^a
<u>Snake basin</u>	28	29.20	20.4%	15.1%	26.3%	272	202	350	10.5%
Dwor-C	9	9.60	6.7%	2.9%	11.8%	90	39	157	--
EF Salmon	1	1.00	0.7%	0.0%	2.1%	9	0	28	--
Imnaha	1	1.03	0.7%	0.0%	2.2%	10	0	29	--
Pahsimeroi	1	1.05	0.7%	0.0%	2.2%	10	0	29	--
SF Clearwater	16	16.52	11.6%	7.2%	16.0%	154	96	213	0%
<u>Up-C basin</u>	2	2.41	1.7%	0.0%	4.2%	23	0	56	--
Wells	1	1.18	0.8%	0.0%	2.5%	11	0	33	--
Winthrop	1	1.23	0.9%	0.0%	2.6%	11	0	34	--
<u>Wild origin--GSI assigned</u>									
<i>All Wild</i>	113	111.39	77.9%	71.9%	83.7%	1,039	959	1,116	--
KLICKR	5	5.00	3.5%	1.4%	6.3%	47	19	84	--
LOWCOL	1	1.00	0.7%	0.0%	2.1%	9	0	28	--
MFSALM	5	5.00	3.5%	1.4%	6.3%	47	19	84	--
MGILCS	74	73.55	51.4%	44.5%	58.4%	686	593	779	--
SFCLWR	7	5.92	4.1%	1.3%	7.3%	55	18	97	--
SFSALM	2	2.00	1.4%	0.0%	3.5%	19	0	47	--

Table 11 (continued)

Stock	Sample size		Percent by stock			Harvest by stock			Percent 1 ocean
	Actual	Adjusted	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci	
SKAMAN	1	1.00	0.7%	0.0%	2.1%	9	0	28	--
UPCLWR	7	7.00	4.9%	2.1%	7.7%	65	28	103	--
UPPCOL	4	4.00	2.8%	0.7%	4.9%	37	9	65	--
UPSALM	7	6.91	4.8%	2.0%	7.7%	64	27	103	--

^a using actual sample size

Table 12. The number of all unclipped fish and large (≥ 78 cm) unclipped fish sampled by stock and the maximum likelihood (ML) estimate of the percentage of the large fish from each stock and the percentage of fish within each stock that were large in the Tribal Zone 6 fishery from August 23 to October 17, 2021.

Stock	Actual number sampled	Actual number of large fish	ML percent of total large	ML total 90% lci	ML total 90% uci	ML percent large within stock	ML within 90% lci	ML within 90% uci
All samples	143	43	--	--	--	--	--	--
Dwor-C	9	7	17.4%	8.0%	27.8%	78.2%	51.4%	100.0%
EF Salmon	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Imnaha	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pahsimeroi	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SF Clearwater	16	15	36.0%	23.3%	48.6%	93.7%	81.8%	100.0%
Wells	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Winthrop	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
<u>Unclipped assigned with GSI</u>								
KLICKR	5	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LOWCOL	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
MFSALM	5	3	7.0%	0.0%	14.0%	60.0%	16.7%	100.0%
MGILCS	74	5	11.6%	4.3%	20.0%	6.8%	2.5%	12.0%
SFCLWR	7	5	9.4%	1.7%	18.2%	68.1%	24.9%	100.0%
SFSALM	2	1	2.3%	0.0%	6.8%	50.0%	0.0%	100.0%
SKAMAN	1	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
UPCLWR	7	6	14.0%	5.5%	23.1%	85.7%	60.0%	100.0%
UPPCOL	4	1	2.3%	0.0%	6.7%	25.0%	0.0%	66.7%
UPSALM	7	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

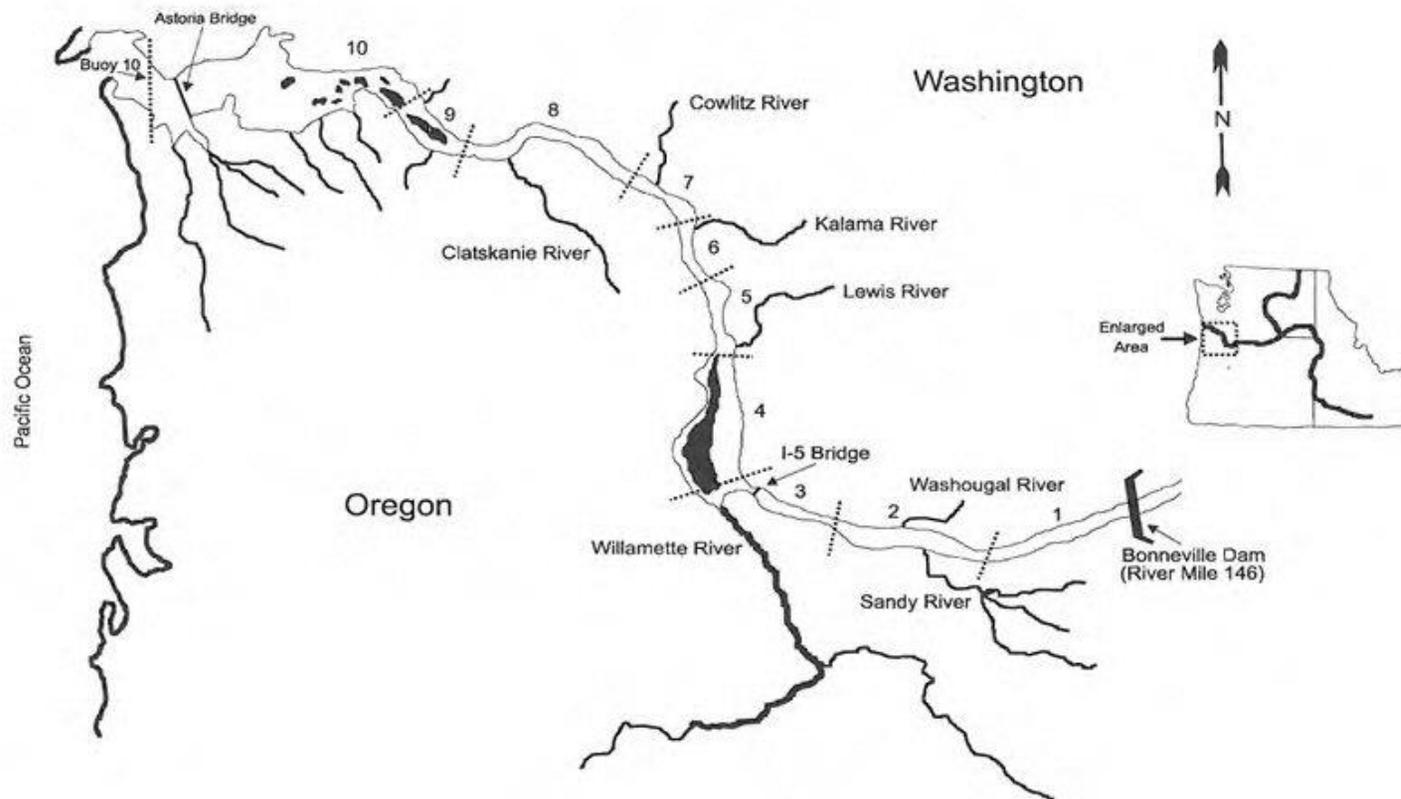


Figure 1. Map of the Lower Columbia River showing the 10 creel survey sections that were used to estimate sport harvest.

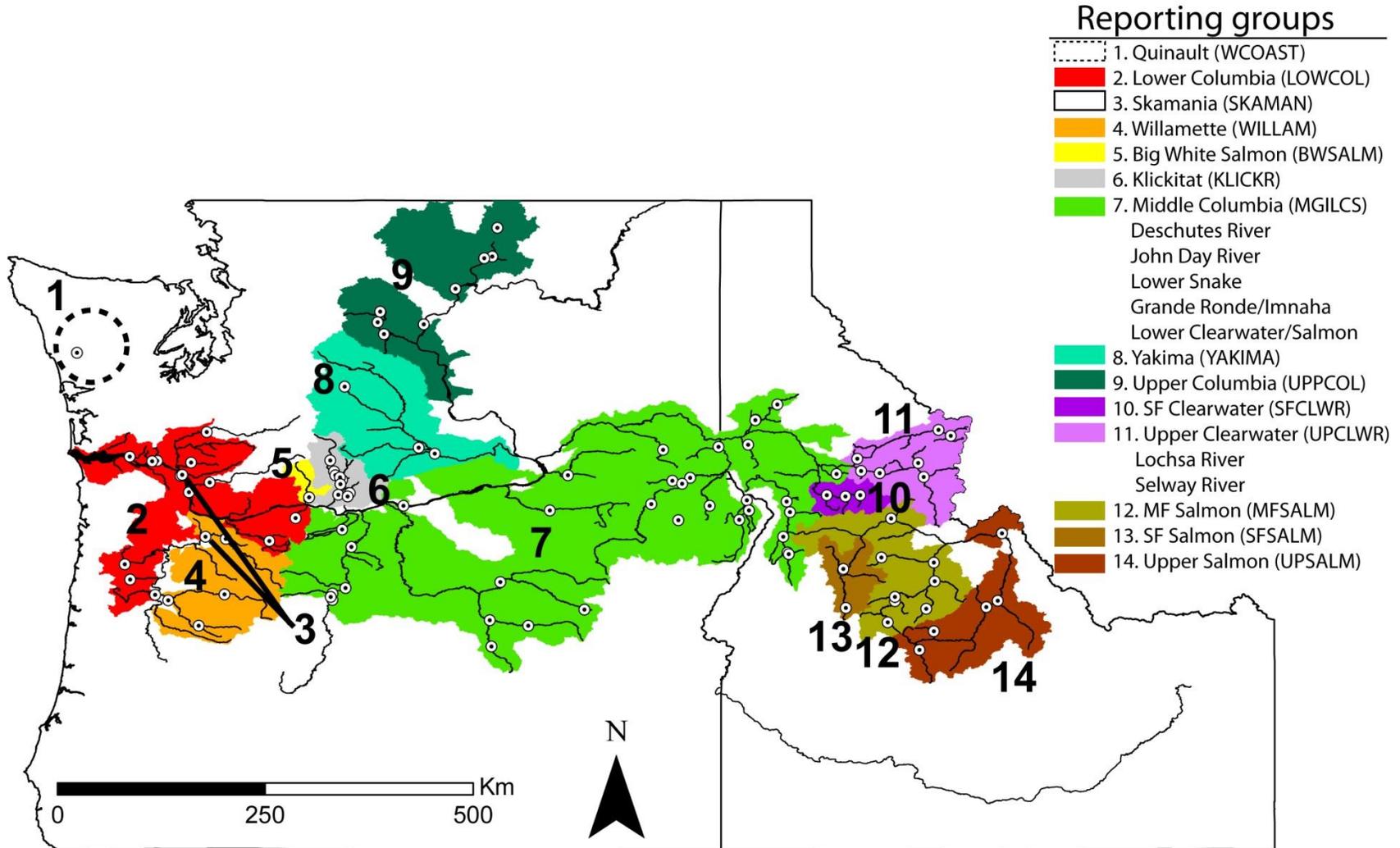


Figure 2. Map of the GSI reporting groups that were developed by CRITFC. These groups were used to assign adipose clipped and adipose unclipped steelhead that were not identified with PBT.

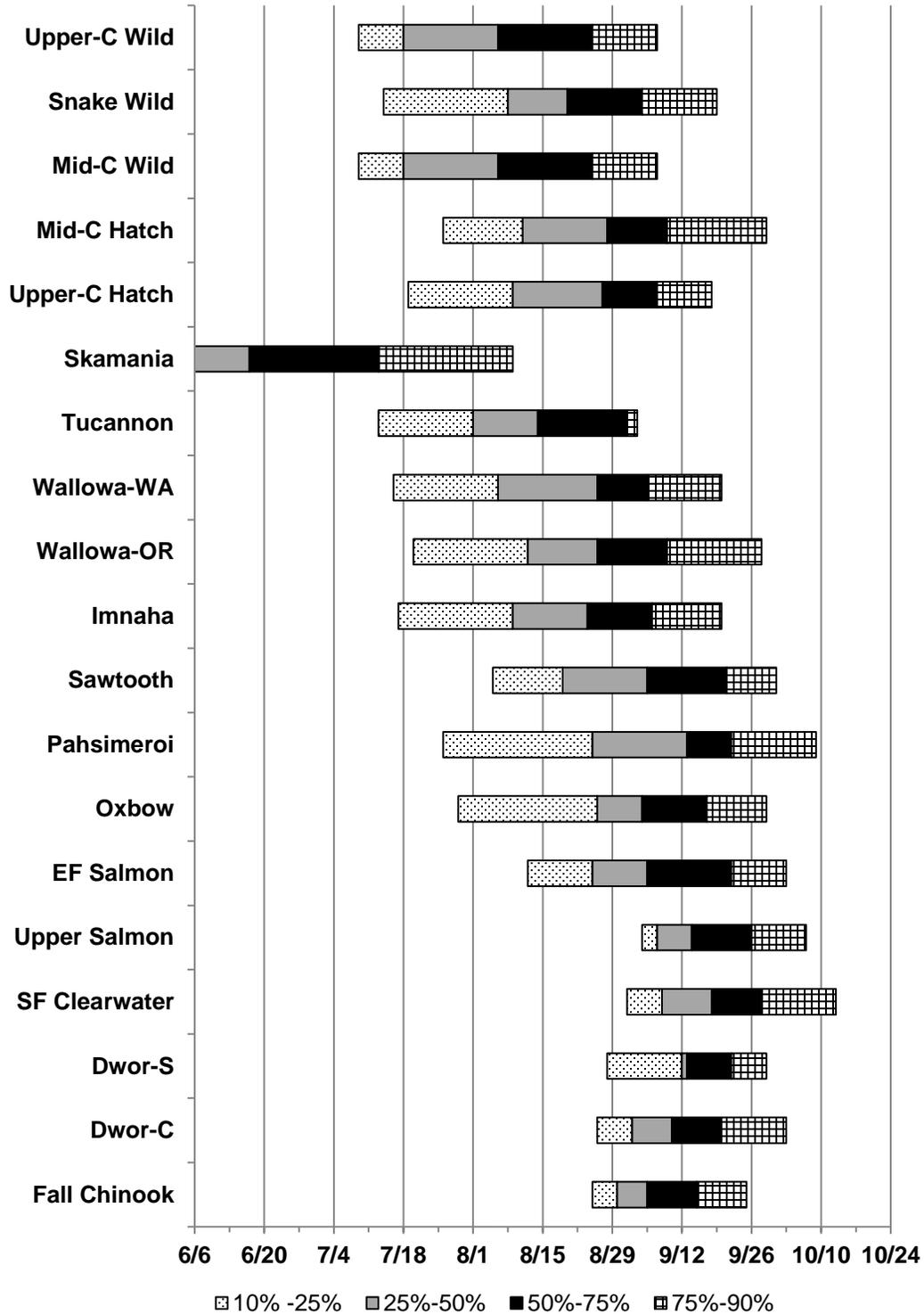


Figure 3. Run-timing of fall Chinook Salmon and hatchery and wild steelhead stocks at Bonneville Dam in 2021. The Skamania stock is for fish released in the Klickitat River and it's 10% and 25% date were May 3 and May 24, respectively. The Snake River wild stock excludes fish tagged at Snake River dams.

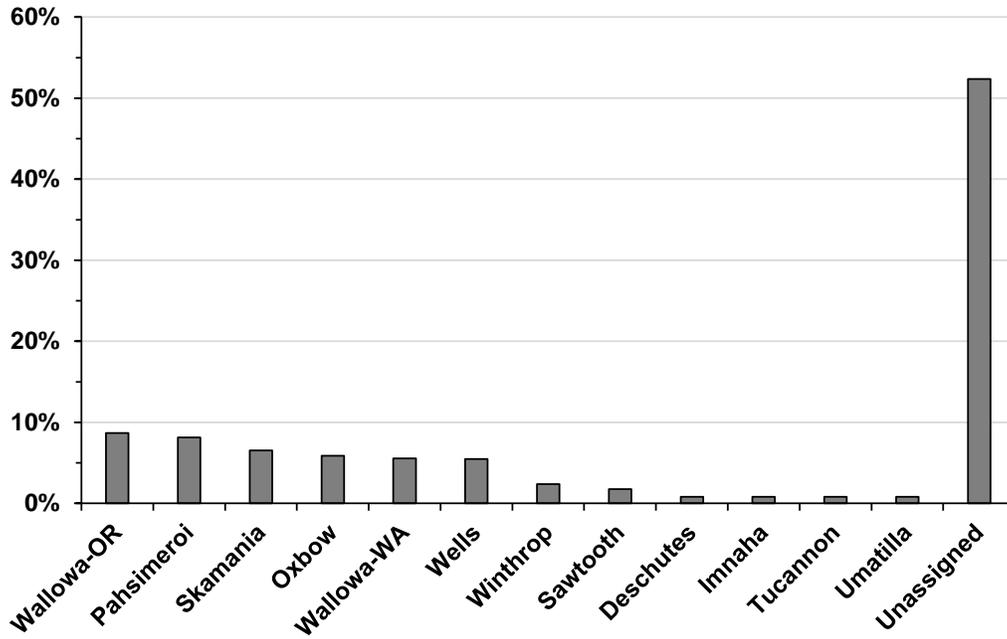


Figure 4. Hatchery stock composition in the Lower Columbia River sport fishery, June 16 to July 31, 2021. PBT assigned fish made up 47.6% of the harvest.

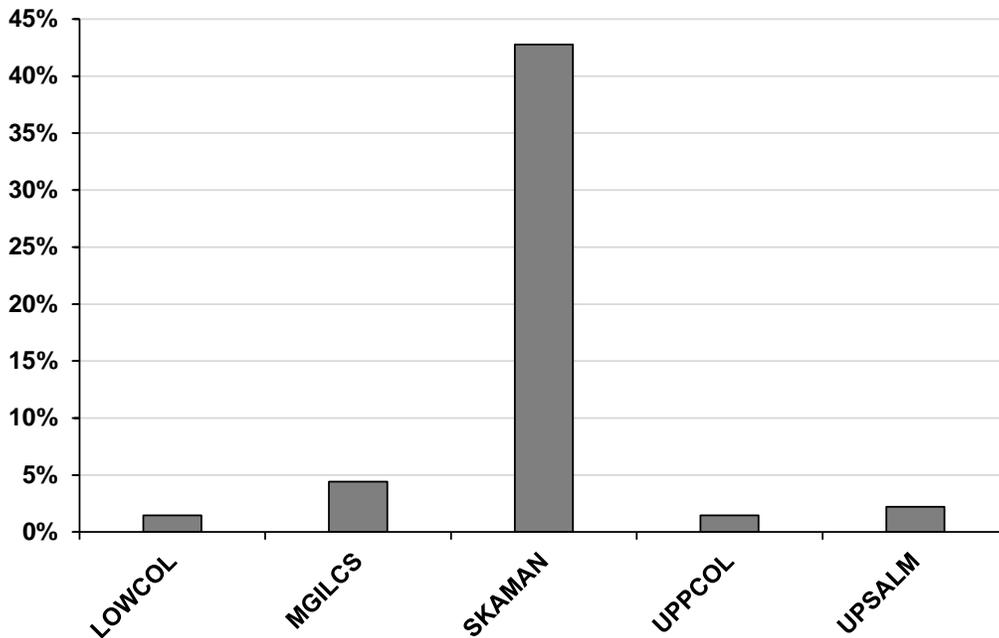


Figure 5. Percent of the total harvest in the Lower Columbia River sport fishery that were assigned to GSI reporting groups, June 16 to July 31, 2021. GSI assigned fish made up 52.4% of the harvest.

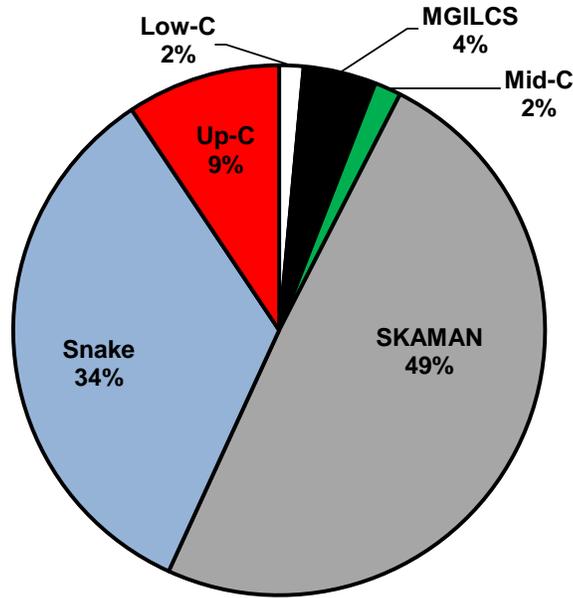


Figure 6. Harvest contribution by basin in the Lower Columbia River sport fishery, June 16 to July 31, 2021.

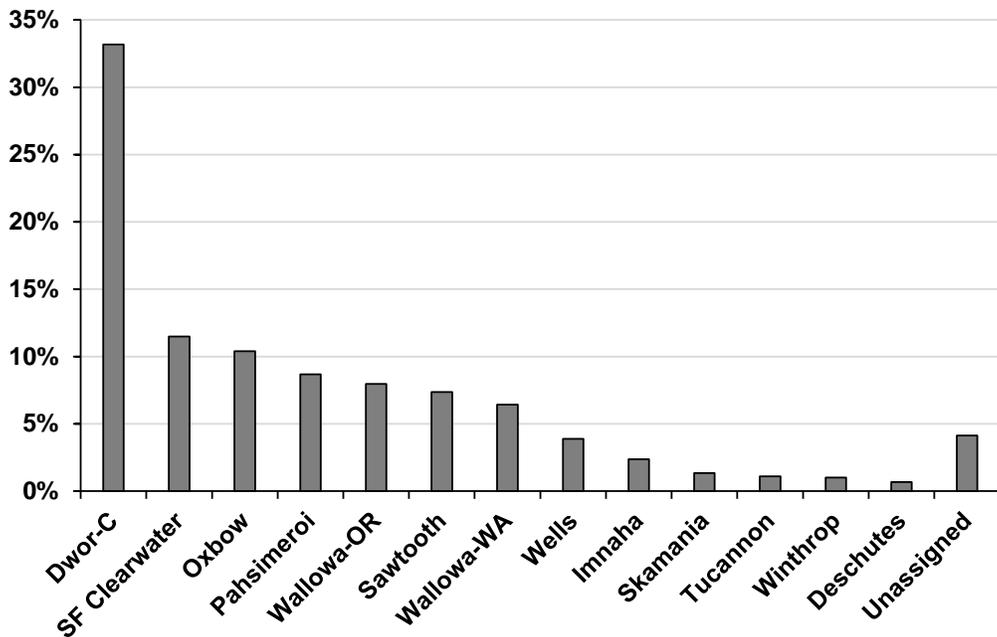


Figure 7. Stock composition of the clipped hatchery origin fish in the Tribal Zone 6 fishery from August 23 to October 17, 2021. Clipped hatchery origin fish made up 95.9% of the clipped fish.

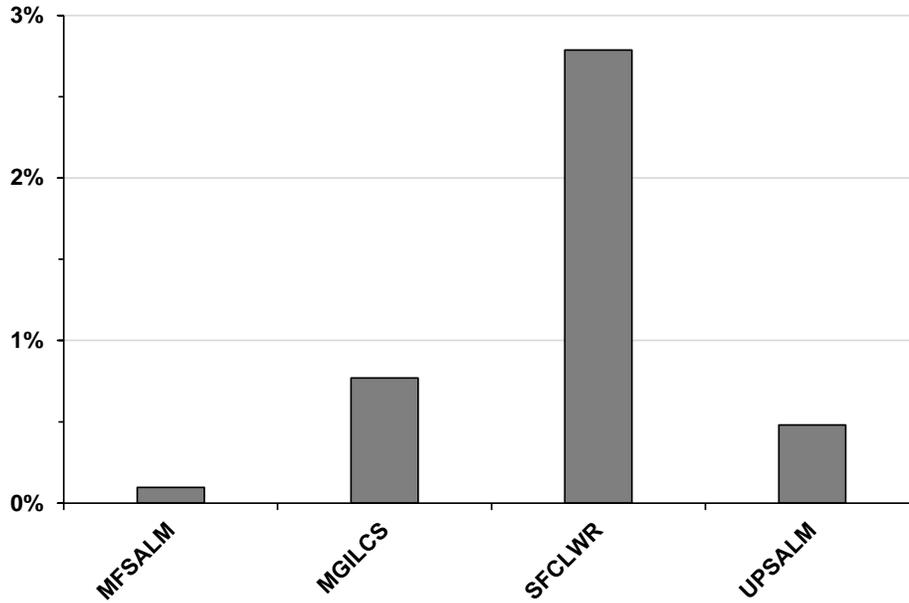


Figure 8. Stock composition of the clipped hatchery origin fish that were assigned to GSI reporting groups in the Tribal Zone 6 fishery from August 23 to October 17, 2021. GSI assigned fish made up 4.1% of the clipped fish.

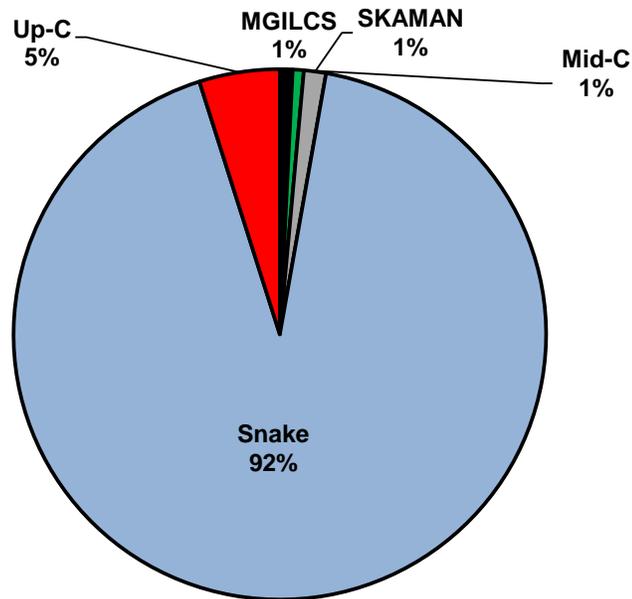


Figure 9. Harvest contribution by basin in the clipped Tribal Zone 6 fishery, August 23 to October 17, 2021.

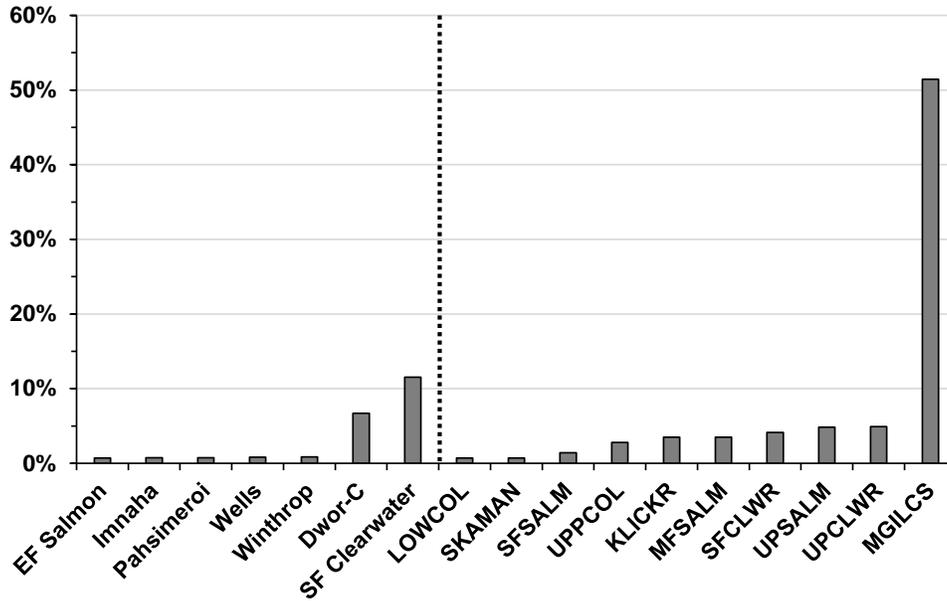


Figure 10. Stock composition of the unclipped fish in the Tribal Zone 6 fishery from August 23 to October 17,2021. Unclipped hatchery origin (left of dashed line) and wild fish (right of dashed line) made up 77.9% and 21.1% of the unclipped harvest, respectively.

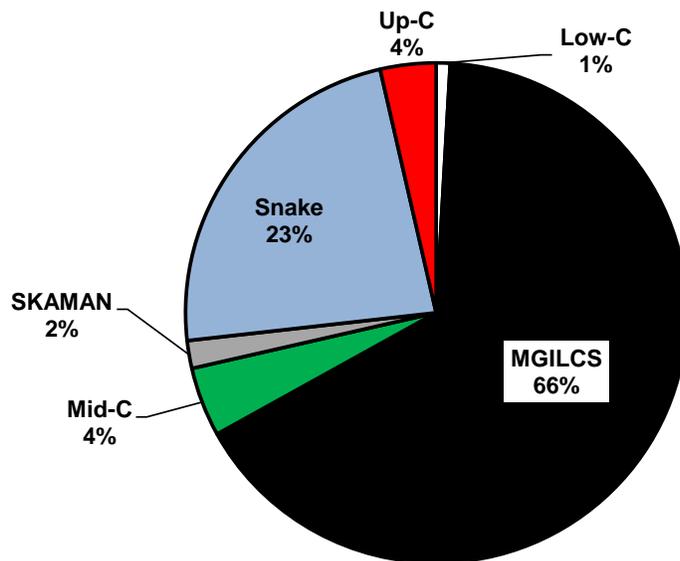


Figure 11. The percentage of wild steelhead caught by basin in the Tribal Zone 6 unclipped fishery from August 23 to October 17,2021. 2020. Wild steelhead made up 77.9% of the unclipped harvest.

Appendix A. Date of arrival at Bonneville Dam of summer steelhead stocks and fall Chinook Salmon in 2021 and the percentage of the stock's passage on August 1 and October 17. The stocks shaded in grey contribute most of the large hatchery origin steelhead during the A/B-Index steelhead passage period at Bonneville Dam.

Stock	Number	Date arrival quantile attained at Bonneville Dam							Passage on		8/1 to
		5%	10%	25%	50%	75%	90%	95%	8/1	10/17	10/17
Fall Chinook	347,780	8/22	8/25	8/30	9/5	9/15	9/25	10/3	--	99%	99%
Dwor-C	89	8/24	8/26	9/2	9/10	9/20	10/3	10/8	0%	100%	100%
Dwor-S	10	8/28	8/28	9/12	9/13	9/22	9/29	10/27	0%	90%	90%
SF Clearwater	80	8/26	9/1	9/8	9/18	9/28	10/13	10/19	0%	94%	94%
Upper Salmon	25	8/31	9/4	9/7	9/14	9/26	10/7	10/31	0%	92%	92%
EF Salmon	17	7/30	8/12	8/25	9/5	9/22	10/3	10/27	6%	94%	88%
Oxbow	64	7/25	7/29	8/26	9/4	9/17	9/29	10/12	11%	98%	88%
Pahsimeroi	45	7/19	7/26	8/25	9/13	9/22	10/9	10/19	11%	91%	80%
Sawtooth	111	7/21	8/5	8/19	9/5	9/21	10/1	10/12	10%	97%	87%
Imnaha	121	7/13	7/17	8/9	8/24	9/6	9/20	9/27	20%	98%	78%
Wallowa-OR	71	7/12	7/20	8/12	8/26	9/9	9/28	10/9	20%	97%	77%
Wallowa-WA ^a	159	7/9	7/16	8/6	8/26	9/5	9/20	9/26	24%	99%	75%
Tucannon	31	7/3	7/13	8/1	8/14	9/1	9/3	9/14	26%	100%	74%
Skamania	43	4/12	5/3	5/24	6/17	7/13	8/9	8/15	86%	100%	14%
Upper-C Hatch	159	7/15	7/19	8/9	8/27	9/7	9/18	9/26	21%	97%	77%
Mid-C Hatch	55	7/19	7/26	8/11	8/28	9/9	9/29	10/9	16%	96%	80%
Mid-C Wild	133	7/4	7/9	7/18	8/6	8/25	9/7	9/22	44%	98%	55%
Snake Wild	133	7/8	7/14	8/8	8/20	9/4	9/19	9/24	18%	99%	81%
Upper-C Wild	31	6/30	7/7	7/25	8/9	8/22	9/7	9/16	32%	100%	68%
MIN Snake hatchery		7/3	7/13	8/1	8/14	9/1	9/3	9/14	0%	90%	74%
MAX Snake hatchery		8/31	9/4	9/12	9/18	9/28	10/13	10/31	26%	100%	100%
Snake duration (days)		59	53	42	35	27	40	47	--	--	

^a Includes fish released in the Walla Walla basin.

Appendix B. Harvest and stock composition estimates by PBT release groups in the Lower Columbia River sport fishery, June 16 to July 31, 2021. All fish were adipose clipped. The total harvest estimate was 1,048. The sum of the components may not equal the total harvest due to rounding error.

PBT Release Group	Percent of harvest			Harvest by groups		
	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
<u>Snake basin stocks</u>						
2018-HNFH-SAWT-SawtoothFH-AdClip	0.86%	0.00%	2.58%	9	0	27
2018-IRRI-WALL-WallowaR	1.63%	0.00%	4.07%	17	0	43
2018-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	0.86%	0.00%	2.58%	9	0	27
2018-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	4.18%	1.67%	7.52%	44	18	79
2018-NIAG-PAHS-LittleSalmonR-AdClip	0.87%	0.00%	2.60%	9	0	27
2018-NIAG-PAHS-PahsimeroiR-AdClip	2.39%	0.80%	4.79%	25	8	50
2019-HNFH-SAWT-SawtoothFH-AdClip	0.89%	0.00%	2.66%	9	0	28
2019-IRRI-IMNA-Imnaha	0.81%	0.00%	2.42%	8	0	25
2019-IRRI-WALL-WallowaR	7.06%	3.92%	10.98%	74	41	115
2019-LYON-TUCA-TucannonR-WA	0.80%	0.00%	2.41%	8	0	25
2019-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	4.69%	1.56%	7.81%	49	16	82
2019-MVFH-PAHS-LittleSalmonR-AdClip	1.60%	0.00%	4.01%	17	0	42
2019-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	1.71%	0.00%	3.41%	18	0	36
2019-NIAG-PAHS-PahsimeroiR-AdClip	3.27%	0.82%	5.72%	34	9	60
<u>Non-Snake basin stocks</u>						
Deschutes2019	0.82%	0.00%	2.45%	9	0	26
Skamania2017	4.15%	1.66%	7.48%	44	17	78
Skamania2018	2.38%	0.79%	4.76%	25	8	50
Umatilla2017	0.80%	0.00%	2.41%	8	0	25
Wells2017	0.82%	0.00%	2.45%	9	0	26
Wells2018	3.75%	1.25%	7.50%	39	13	79

Appendix B (continued)

PBT Release Group	Percent of harvest			Harvest by groups		
	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
<u>Non-Snake basin stocks</u>						
Wells2019	0.92%	0.00%	2.77%	10	0	29
Winthrop2017	0.78%	0.00%	2.34%	8	0	25
Winthrop2018	1.61%	0.00%	4.03%	17	0	42
<i>All PBT assigned</i>	47.65%	39.89%	55.62%	499	418	583
<i>PBT Unassigned</i>	52.35%	44.38%	60.11%	549	465	630

Appendix C. Harvest and stock composition estimates by PBT release groups in the Tribal Zone 6 fishery from August 23 to October 17, 2021. The harvest estimate was 1,996 and 1,334 for clipped and unclipped steelhead, respectively. The sum of the components may not equal the total harvest due to rounding error.

PBT Release Group	Percent of harvest			Harvest by groups		
	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
Clipped harvest	--	--	--	1,916	na	na
<i>Snake basin stocks</i>						
2017-CLWH-SFCR-MeadowCr-AdClip	0.65%	0.00%	1.31%	13	0	25
2017-DWOR-DWOR-NFClearwaterR-AdClip	1.10%	0.00%	2.20%	21	0	42
2017-DWOR-DWOR-RedHouse-AdClip	0.34%	0.00%	1.02%	7	0	20
2017-IRRI-WALL-GrandeRondeR/WallowaR	0.33%	0.00%	1.00%	6	0	19
2017-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	0.60%	0.00%	1.79%	11	0	34
2017-NIAG-PAHS-PahsimeroiR-AdClip	0.34%	0.00%	1.01%	6	0	19
2018-CLWH-SFCR-MeadowCr-AdClip	4.20%	2.45%	6.30%	81	47	121
2018-CLWH-SFCR-RedHouse-AdClip	4.95%	2.83%	7.07%	95	54	135
2018-DWOR-DWOR-ClearCr-AdClip	2.29%	0.00%	5.08%	44	0	97
2018-DWOR-DWOR-NFClearwaterR-AdClip	21.75%	17.55%	25.95%	417	336	497
2018-DWOR-DWOR-RedHouse-AdClip	4.58%	2.47%	6.69%	88	47	128
2018-HNFH-SAWT-SawtoothFH-AdClip	1.08%	0.00%	2.16%	21	0	41
2018-IRRI-WALL-WallowaR	2.38%	1.02%	4.09%	46	20	78
2018-LYON-TUCA-TucannonR-WA	1.10%	0.36%	2.20%	21	7	42
2018-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	2.51%	1.08%	4.31%	48	21	83
2018-MVFH-PAHS-LittleSalmonR-AdClip	0.36%	0.00%	1.08%	7	0	21
2018-NIAG-OXBO-LittleSalmonR-AdClip	1.05%	0.00%	2.10%	20	0	40
2018-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	3.85%	2.10%	5.92%	74	40	113
2018-NIAG-PAHS-LittleSalmonR-AdClip	0.36%	0.00%	1.09%	7	0	21
2018-NIAG-PAHS-PahsimeroiR-AdClip	1.00%	0.33%	2.00%	19	6	38

Appendix C (continued)

PBT Release Group	Percent of harvest			Harvest by groups		
	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
Clipped harvest	--	--	--	1,916	na	na
<u>Snake basin stocks</u>						
2019-CLWH-SFCR-MeadowCr-AdClip	1.34%	0.34%	2.68%	26	6	51
2019-CLWH-SFCR-RedHouse-AdClip	0.34%	0.00%	1.03%	7	0	20
2019-DWOR-DWOR-ClearCr-AdClip	0.33%	0.00%	0.98%	6	0	19
2019-DWOR-DWOR-NFClearwaterR-AdClip	2.44%	1.04%	4.17%	47	20	80
2019-DWOR-DWOR-RedHouse-AdClip	0.35%	0.00%	1.05%	7	0	20
2019-HNFH-SAWT-SawtoothFH-AdClip	5.93%	3.70%	8.52%	114	71	163
2019-IRRI-IMNA-Imnaha	2.36%	1.01%	4.05%	45	19	78
2019-IRRI-WALL-WallowaR	5.25%	3.28%	7.55%	101	63	145
2019-LYON-WALL-CottonWoodGR/LyonsFerry/Touchet-WA	3.92%	2.29%	5.88%	75	44	113
2019-MVFH-PAHS-LittleSalmonR-AdClip	2.01%	0.67%	3.35%	39	13	64
2019-MVFH-SAWT-SawtoothFH-AdClip	0.35%	0.00%	1.06%	7	0	20
2019-NIAG-OXBO-LittleSalmonR-AdClip	1.69%	0.68%	3.05%	32	13	58
2019-NIAG-OXBO-SnakeR-HellsCanyon-AdClip	3.21%	1.43%	5.00%	62	27	96
2019-NIAG-PAHS-LittleSalmonR-AdClip	0.86%	0.00%	2.06%	16	0	39
2019-NIAG-PAHS-PahsimeroiR-AdClip	3.76%	2.05%	5.81%	72	39	111
<u>Non-Snake basin stocks</u>						
Deschutes2018	0.33%	0.00%	1.00%	6	0	19
Deschutes2019	0.34%	0.00%	1.02%	7	0	20
Skamania2017	0.35%	0.00%	1.04%	7	0	20
Skamania2018	0.33%	0.00%	1.00%	6	0	19
Skamania2019	0.66%	0.00%	1.32%	13	0	25
Wells2018	1.57%	0.51%	3.14%	30	10	60
Wells2019	2.32%	0.77%	3.86%	44	15	74
Winthrop2017	0.33%	0.00%	0.98%	6	0	19
Winthrop2018	0.67%	0.00%	1.68%	13	0	32

Appendix C (continued)

PBT Release Group	Percent of harvest			Harvest by groups		
	Estimate	90% lci	90% uci	Estimate	90% lci	90% uci
<i>All clipped PBT assigned</i>	95.87%	91.71%	100.00%	1,837	1,757	1,916
<i>PBT clipped Unassigned</i>	4.13%	0.00%	8.29%	79	0	159
Unclipped harvest	--	--	--	1,334	na	na
<u>Snake basin stocks</u>						
2017-DWOR-DWOR-LoloCr-NoClip	0.70%	0.00%	2.10%	9	0	28
2018-CLWH-SFCR-MeadowCr-AdClip	0.75%	0.00%	2.25%	10	0	30
2018-CLWH-SFCR-MeadowCr-NoClip	7.95%	4.34%	11.56%	106	58	154
2018-CLWH-SFCR-NewsomeCr-NoClip	2.10%	0.70%	4.20%	28	9	56
2018-CLWH-SFCR-RedHouse-AdClip	0.76%	0.00%	2.27%	10	0	30
2018-DWOR-DWOR-NFClearwaterR-AdClip	1.63%	0.00%	4.08%	22	0	54
2018-DWOR-DWOR-RedHouse-NoClip	4.38%	1.46%	7.30%	58	19	97
2019-HNFH-EFNAT-EastForkSalmonR-NoClip	0.70%	0.00%	2.10%	9	0	28
2019-IRRI-IMNA-Imnaha	0.72%	0.00%	2.17%	10	0	29
2019-NIAG-PAHS-PahsimeroiR-AdClip	0.73%	0.00%	2.20%	10	0	29
<u>Non-Snake basin stocks</u>						
Wells2019	0.83%	0.00%	2.48%	11	0	33
Winthrop2019	0.86%	0.00%	2.59%	11	0	34
<i>All unclipped PBT assigned</i>	22.11%	16.31%	28.11%	295	218	375
<i>All unclipped GSI assigned (wild fish)</i>	77.89%	71.89%	83.69%	1,039	959	1,116

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